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ANNUAL REPORT

OF

The Connecticut Agricultural

EXPERIMENT STATION

For 1882.

PRINTED BY ORDER OF THE LEGISLATURE.

NEW HAVEN:
TUTTLE, MOREHOUSE & TAYLOR, PRINTERS.
1883.

STATE OF CONNECTICUT.

591-15½

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OFFICERS

OF

The Connecticut Agricultural Experiment Station,

1882.

STATE BOARD OF CONTROL.

Ex-officio.
HIS EXC. HOBART B. BIGELOW, *President.*

		Term expires
	Appointed by Connecticut State Agricultural Society:	
	HON. E. H. HYDE, Stafford, *Vice-President.*	1885.
	Appointed by Board of Trustees of Wesleyan University:	
	PROF. W. O. ATWATER, Middletown.	1882.
	Appointed by Board of Agriculture:	
	T. S. GOLD, West Cornwall.	1883.
	Appointed by Governor and Senate:	
	EDWIN HOYT, New Canaan.	1883.
Executive Committee.	JAMES J. WEBB, Hamden.	1884.
	Appointed by Governing Board of Sheffield Scientific School:	
	W. H. BREWER, New Haven, *Secretary and Treasurer.*	1884.
	Ex-officio.	
	S. W. JOHNSON, New Haven, *Director.*	

Chemists.

E. H. JENKINS, PH.D.
C. A. HUTCHINSON, B.S.
GEO. ARCHER, from April to September

In charge of Buildings and Grounds.
CHARLES J. RICE.

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, waters, milks, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on the various subjects of Agricultural Science, for the use and advantage of the Citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, &c., &c. for the Citizens of Connecticut *without charge*, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 15.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be prepaid, and all communications should be directed, not to individual officers, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban St., between Whitney Avenue and Prospect St., 1¼ miles North of City Hall. Suburban St. may be reached by Whitney Lake Horse Cars, which leave corner of Chapel and Church Sts. each hour and half hour.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State St., or from Peck and Bishop's Office in Union R. R. Depot.

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ERRATA.

Page 14, 3d line from top, read *ingredients* instead of *ingredient*.
Page 16, 10th line from top, read *nor* instead of *or*.
Page 17, 14th line from top, read *samples* instead of *same*.
Page 32, 1st line from top, read *phates*, 8, *superphosphates*.
Page 65, 5th line from bottom, read *Our* instead of *One*.
Page 88, 17th line from top, read *the specific gravity* instead of *it*.

REPORT OF THE BOARD OF CONTROL.

To the General Assembly of the State of Connecticut:

GENTLEMEN:—The Board of Control of THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION herewith submits to your Honorable Body the Annual Reports of the Director and Treasurer made to this Board at its Annual Meeting held at the State House in Hartford, January 16th, 1883.

We beg leave to say that at a special meeting of this Board held May 9th. various parcels of ground were visited and one chosen for purchase for the use of the Station, and a special committee was appointed to carry out the objects of the act passed by the Legislature at its last session, appropriating twenty-five thousand dollars "for the purpose of buying a suitable lot and erecting thereon buildings and equipping the same for the permanent use of said Station." (See p. 108.)

The special committee was made up of His Excellency Hobart B. Bigelow, chairman, J. J. Webb, vice-chairman, William H. Brewer, secretary, S. W. Johnson and T. S. Gold. This committee reports that the property recommended by the Board of Control for purchase was bought May 9th, 1882; it consists of about five acres of land situated on Suburban St., nearly one mile and five-eighths in air line from the City Hall of New Haven, having on it a commodious dwelling house, a barn and well. A substantial brick building has been erected for a chemical laboratory. Water and gas have been laid on. The fixtures of the laboratory are nearly complete. Most of the needed repairs on the house and barn have been made, and the further equipment is in progress and well advanced. The original property cost $12,000.00, and $8,809.04 have thus far been paid out on the new building and for repairs and equipment.

The usual work of the Station went on in the rooms of the Sheffield Scientific School until September 1st, when the Station office was opened at its new and permanent quarters.

The last Annual Report was bound and distributed as heretofore with the Report of the Board of Agriculture. By Special Resolution the Legislature ordered the printing of 2000 extra copies, a large share of which were distributed in advance of the regular edition. These extra copies cost less than 10 cents each, and the demand for them makes similar action desirable this year.

THOMAS M. WALLER,
President.

WM. H. BREWER,
Secretary.

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with The Connecticut Agricultural Experiment Station.*

Receipts.

Balance from account of 1881,	$611.09	
Licenses for sale of Fertilizers,	315.00	
Miscellaneous Receipts,	705.67	
State Treasurer—Annual Appropriation,	7,000.00	
		$8,631.76

Payments.

Salaries,	$4,411.67	
Laboratory Expenses,	763.87	
Printing, Postage and Stationery,	369.79	
Traveling Expenses of the Board,	63.33	
Gas and Fuel,	235.50	
General Expenses,	1,113.92	
Cash Balance on hand,	1,673.68	
		$8,631.76

WM. H. BREWER,
Treasurer.

Memorandum.

There is due the Experiment Station one hundred ten $\frac{30}{100}$ dollars for laboratory work and the outstanding bills and liabilities (mostly for apparatus and material) are estimated to amount to seventeen hundred (1700) dollars.

Of the special appropriation "for the purpose of buying a suitable lot and erecting thereon buildings and equipping the same for the permanent use of the Station," twenty thousand eight hundred nine dollars and four cents ($20,809.04) have been paid out for property purchased and for work already done and accepted.

WM. H. BREWER,
Treasurer.

REPORT OF THE DIRECTOR.

The chemical work done at the Station during the year 1882 was necessarily completed for the most part previous to Sept. 1, as on that day the rooms in Sheffield Hall which had been occupied for five years and two months as laboratory and office were vacated, the Station property having been packed up and stored, to await the completion of its new laboratory. Notwithstanding this short period of work nearly the usual number of fertilizer analyses were made, viz: 151, and of these a large proportion were on samples of complex composition.

Two samples of soil and three of swamp muck have been examined. The results are set forth on subsequent pages, with such comments as seem appropriate.

In response to an application from the Wilton Farmer's Club, through the secretary, D. H. Van Hoosear, Esq., five samples of fine salt and one of saltpeter have been submitted to analysis, and their use as antiseptic or preservative material discussed in answering several questions proposed by the Club.

The testing of milk has assumed much prominence, 216 analyses, partial or complete, having been executed. Dr. Jenkins has ably discussed the results of these and of the 56 samples analyzed last year, so far as they have importance for the public, in a paper which follows.

Of fodders six complete analyses and fourteen partial analyses have been undertaken. The results on ensilage will be read with special interest.

Two toxical examinations were made with negative or undecisive results.

Twenty-four seed-tests are reported, made mostly on sweet-corn and onion seed.

The Bulletins of the Station have been only five in number, but they have aggregated 34 carefully printed pages of the style of this Report, and were stitched for convenience of preservation. These have been sent as usual to all of the Agricultural Societies and Farmers' Clubs and to all the newspapers in the State. They have been reprinted in the *Connecticut Farmer* and in agricultural papers in other States. In anticipation of the act requiring the Station after Sept. 1, 1882, to "mail or cause to be mailed two copies, at least," of its bulletins, to each post-office in the State, 6,000 copies of Bulletins 71 and 72 were distributed by post in special envelopes addressed to the postmasters, on which was printed the following:

> "The Director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said Station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State."
>
> *Section* 10 *of "An Act concerning Commercial Fertilizers," passed by the General Assembly, to take effect Sept.* 1, 1882.
>
> ☞ The postmaster will greatly serve the public by distributing the enclosed bulletins to farmers.☜

Hereafter the Station will dispatch to every Connecticut post-office a package of each of its bulletins, so that they may be universally accessible to the farmers of Connecticut.

Fertilizer Law.

The General Assembly at its last session passed a new Fertilizer Law, which went into effect Sept. 1, and which repeals and takes the place of all previous legislation on this subject in this State.

Since a full understanding of the provisions and penalties of this law is important to all parties who buy or sell commercial fertilizers, attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law of 1882 holds the *seller* responsible for affixing a correct label or statement to every package or lot sold or offered, as well as for the payment of an analysis fee of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to con-

tain, unless the manufacturer or importer shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a certified statement of composition, net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a sealed sample shal be deposited with him. Section 2.

3. It is also provided that every person in the State who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

Here follows the full text of the law:

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

General Assembly,
January Session, A. D. 1882.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

Sec. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said Director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, shall pay, on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and the address of manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

SEC. 6. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said Experiment Station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

SEC. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

SEC. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

SEC. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the Station, and shall cause one or more analyses of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

SEC. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said Station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed.

SEC. 12. This act shall take effect on the first day of September, 1882.

FORM OF MANUFACTURER'S STATEMENT TO AFFIX TO PACKAGES.

At the request of several manufacturers, the following examples of statement are given for use in complying with Section 1 of the Act.

JOHN DOE'S SUPERPHOSPHATE.

This lot or package (bag or barrel) contains (or is guaranteed to contain) 250 net pounds of JOHN DOE'S SUPERPHOSPHATE, manufactured at New Haven, Ct., and having the following chemical composition, per cent., viz:

Nitrogen in nitrates,	2.1
" ammonia-salts,	1.5
" organic-matter,	1.5
Soluble phosphoric acid,	8.0
Reverted " "	1.5
Insoluble " "	1.0
Potash, as sulphate (or muriate),	4.3

John Doe, Manufacturer, New Haven, Ct.

The above statement of chemical composition will cover SUPERPHOSPHATES and SPECIAL MANURES when it is desired to specify minutely the state of the ingredient. Ingredients that are not present may of course be omitted in the statement, and others may be named if it is desired.

In most cases manufacturers necessarily avail themselves of the cheapest sources of nitrogen, and substitute nitrates for ammonia salts or the reverse according to the state of the market. It is therefore not easy to maintain any exact distinction as to nitrates, ammonia salts and organic nitrogen. Some prefer also to group together soluble and reverted phosphoric acid, and to use low-grade potash-salts which contain both sulphates and muriates.

In such cases the statement of composition may be confined to Nitrogen, Soluble and Reverted Phosphoric acid, Insoluble Phosphoric acid, Potash.

In case of BONE, FISH, TANKAGE, DRIED MEAT, DRIED BLOOD, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric acid.

For POTASH SALTS give the per cent. of Potash (potassium oxide), and of Sulphate of potash or Muriate of potash.

The chemical composition of other fertilizers may be given as found in the Station Reports.

The common use of the word "ammonia" in place of nitrogen, as applied to articles really containing no ammonia or ammonia-salts, is not "approved" as it is not "currently employed by the Connecticut Agricultural Experiment Station." The same is true of the use of the terms "available" and "assimilable" as covering soluble and reduced phosphoric acid.

The Station in analyzing the fertilizers sold under this law, as a rule, can take account of those ingredients only which are specified in the Statement that accompanies each package sold.

FORM OF DEALER'S REPORT TO THE STATION.

Section 4 of the Act requires that every person in this State who sells or acts as local agent for the sale of any Commercial Fertilizer of whatever kind or price, shall, *annually* or *at the time of becoming* such agent or seller, make a report to the Director of the Experiment Station. The subjoined form may be used for such reports.

I (we), the undersigned, hereby report to the Director of the Connecticut Agricultural Experiment Station, as required by law, that I am agent (we are agents) for the sale of (here give correct full name and brand of fertilizer) manufactured (imported, furnished) by (here give name and address of manufacturer, importer or party from whom the fertilizer was obtained) and hold myself (ourselves) prepared to deliver to said Director a sample of the same on his demand.

Sign with name,
Residence,
Post Office Address,
And Date.

Blanks for making out these Reports will be supplied on application to the Experiment Station.

On receiving Statements and analysis-fees from manufacturers and Reports from dealers, the Station will issue receipts for the same.

FERTILIZERS.*

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that can work against the public good.

During 1882, one hundred and fifty-one (151) samples of fertilizers have been analyzed. Of these, 34 were examined for private parties, and the remainder, 117, for the general use of the citizens of the State.

The samples analyzed for the public benefit have been sent in from various quarters of the State, in most instances by actual purchasers and consumers, in a few cases by dealers, while the Station itself, through authorized agents, has drawn a considerable number of samples from the stock of dealers and agents.

All the analyses of the first class are made on samples understood to have been taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

---

* The matter of this and of several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied with a few appropriate alterations from the Report for 1881. This repetition appears to be necessary for the use of readers who have not seen former Reports.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

The *Commercial Value* of a high-priced Fertilizer can be estimated, if the amounts *per cent.* of its principal fertilizing elements are known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains or loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit-can or tin box, holding about one quart, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

THE CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

The foregoing instructions may be over-nice in some cases, but they are not intended to take the place of good sense on the part of those who are interested in learning the true composition of a fertilizer. Any method of operating that will yield a *fair sample* is good enough.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin tube, like a dipper handle, put well down into the packages, in a good number of places will give a fair sample with great ease. With dry, coarse articles, such as ground bone, there is likely to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling. Otherwise the analysis will certainly misrepresent the article whose value it is intended to fix.

The quantity sent should not be too small. When the material is fine and uniform, and has been carefully sampled, a pint may be enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the same should not be *less than one quart.*

It is also important that samples for analysis should be taken at the time when the fertilizer is purchased, and immediately dispatched to the Station. Moist fish, blood or cotton seed will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

These changes in the composition of a sample not suitably preserved must invalidate any conclusions from its analysis, and work serious injustice either to the manufacturer or to the consumer.

It doubtless often happens that a purchaser on laying in a stock of fertilizers decides that he will not then trouble the Station to analyze the goods he has obtained, but will set aside samples which he can send for examination in case the crops report adversely as to their quality. It is always better to send all samples at once to the Station where they can be directly analyzed or so prepared that they will keep without chemical change.

With the Instructions for Sampling, the Station furnishes a blank Form for Description of Samples, a copy of which is here given.

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION,

New Haven, Conn.

Form for Description of Sample.

Station No............ Rec'd at Station,.................18

Each sample of Fertilizers sent for gratuitous analysis must be accompanied by one of these Forms, with the blanks *below* filled out fully and legibly.

The filled out Form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

Brand of Fertilizer,..

Name and address of Manufacturer,..........................

....

Name and address of Dealer from whose stock this sample is taken, ...

Date of taking this sample,...................................

Selling price per ton or hundred, bag or barrel, ...

Selling weight claimed for each package weighed,..............

Actual weight of packages opened,.............................

Here write a copy of any analysis or guaranteed composition that is fixed to the packages.

....

Signature and P. O. address of person taking and sending the sample.

....

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description," which accompanies it is filed in the Station's Record of Analyses and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description" when properly filled out, also contains all the data of cost, weight, etc., of a fertilizer which are necessary for estimating, with help of the analysis, the commercial value of its fertilizing elements, and the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the Description may work injustice to the manufacturers or dealers as well as mislead consumers. It is especially important that the *Brand* of a fertilizer and its *Selling price* should be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton-prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

When a sample of fertilizer has been analyzed, the results are entered on a printed form, which is filed in the Station Record of Analyses, facing the "Description of Sample" that was received with the fertilizer to which it pertains, and there remains for future reference.

A copy of the analysis is also immediately reported to the party that furnished the sample, the report being entered on one page of another printed form and facing a second printed page of "Explanations" intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages and are therefore reproduced here, as follows:

EXPLANATIONS OF FERTILIZER-ANALYSIS AND VALUATION.

Nitrogen is commercially the most valuable fertilizing element. It occurs in various forms or states. *Organic nitrogen* is the nitrogen of animal and vegetable matters generally, existing in the albumen and fibrin of meat and blood, in the uric acid of bird dung, in the urea and hippuric acid of urine, and in a number of other substances. Some forms of organic nitrogen, as that of blood and meat, are highly active as fertilizers; others, as that of hair and leather, are comparatively slow in their effect on vegetation unless these matters are reduced to a fine powder or chemically disintegrated. *Ammonia* and *nitric acid* are results of the alteration of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda.

17 parts of ammonia, or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen.

85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced by acting on "insoluble" or "reverted" phosphates with oil of vitriol. It is not only readily taken up by plants, but is distributed through the soil by rains. Once well incorporated with soil it shortly becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *Phosphoric acid* strictly means phosphoric acid that was once freely soluble in water, but from chemical change has become insoluble in that liquid. It is freely taken up by a strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops, but generally have less value than soluble phosphoric acid, because they do not distribute freely by rain.

Insoluble Phosphoric acid implies various phosphates not freely soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be rapidly available as plant food. This is true of South Carolina rock phosphate, of Navassa phosphate, and especially of Canada apatite. The phosphate of coarse raw bones is at first nearly insoluble in this sense, because of the animal matter of the bone which envelopes it, but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It is most costly in the form of sulphate, and cheapest in the shape of muriate or chloride.

The Valuation of a Fertilizer signifies estimating its worth in money, or its trade-value; a value which, it should be remembered, is not *necessarily* proportional to its fertilizing effects in any special case.

Plaster, lime, stable manure and nearly all the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and other fertilizers, for which $30 to $80 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is easily estimated from the market prices of the standard articles which furnish them to commerce.

The average Trade-values, or cost in market per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the Connecticut and New York markets, and employed by the Station during the last two years, have been as follows:

TRADE-VALUES FOR 1881 AND 1882.

	1881. Cents per lb.	1882. Cents per lb.
Nitrogen in nitrates,	26	26
" in ammonia salts,	22½	29
" in Peruvian Guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures,	20	24
" in coarse or moist blood, meat or tankage, in cotton seed, linseed and Castor Pomace,	16	18
" in fine ground bone, horn and wool dust,	15	17
" in fine medium bone,	14	15
" in medium bone,	13	14
" in coarse medium bone,	12	13
" in coarse bone, horn shavings, hair and fish scrap,	11	11
Phosphoric acid soluble in water,	12½	12½
" " "reverted" and in Peruvian Guano,	9	9
" " insoluble, in fine bone, fish guano and superphosphates,	6	6
" " " in fine medium bone,	5½	5½
" " " in medium bone,	5	5
" " " in coarse medium bone,	4½	4½
" " " in coarse bone, bone ash and bone black,	4	4
" " " in fine ground rock phosphate,	3½	3
Potash in high grade sulphate,	7½	7
" in low grade sulphate and kainite,	5½	5
" in muriate or potassium chloride,	4½	5

These "trade-values" of the elements of fertilizers are not fixed, but vary with the state of the market, and are from time to time subject to revision. They are not exact to the cent or its fraction, because the same article sells cheaper at commercial or manufacturing centers than in country towns, cheaper in large lots than in small, cheaper for cash than on time. These values are high enough to do no injustice to the dealer, and properly interpreted, are accurate enough to serve the object of the consumer.

To Estimate the Value of a Fertilizer we multiply the per cent. of nitrogen, etc., by the trade-value per pound, and that product by 20; we thus get the values per ton of the several ingredients, and adding them together we obtain the total estimated value per ton.

In case of *Ground bone,* the fineness of the sample is graded by sifting, and we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking one one-hundredth of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone. For further particulars, see page 38.

The uses of the "Valuation" are, 1st, to show whether a given lot or brand of fertilizer is worth as a commodity of trade what it costs. If the selling price is no higher than the estimated value, the purchaser may be quite sure that the price is reasonable. If the selling price is but $2 to $3 per ton more than the estimated value, it may still be a fair price; but if the cost per ton is $5 or more over the estimated value, it would be well to look further. 2d, Comparisons of the estimated values and selling prices of a number of fertilizers will generally indicate fairly which is the best for the money. But the "estimated value" is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that

Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are estimated from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor. It should be remembered that, in an Annual Report, the fluctuations in trade-value that may occur within the year cannot be accurately followed, and the comparisons of estimated values are mostly in retrospect.

The valuations for 1882 were adopted in consultation with Dr. Goessmann, Inspector of Fertilizers for Massachusetts, and Prof. Cook, Director of, and Dr. Neale, Chemist to, the New Jersey Agricultural Experiment Station, and have been employed by these gentlemen in their official Reports for 1882.

ANALYSES AND VALUATIONS OF FERTILIZERS.

The classification of the Fertilizers analyzed in the Station Laboratory from Nov. 1st, 1881, to Sept. 1st, 1882, is as follows:

13 phosphate rocks and phosphatic (non-nitrogenous) guanos.
4 plain (non-nitrogenous) superphosphates.
49 nitrogenous (ammoniated) superphosphates and guanos.
23 special fertilizers or "formulas."
18 bone manures.
2 fish manures.
6 nitrates.
1 sulphate of ammonia.
6 dried blood and tankage.
1 dried meat.
4 castor pomace and cotton seed meal.
1 fowl manure.
1 compost of tripe refuse.
1 damaged tea.
9 potash salts.
1 plaster.
2 slaked lime.
2 limestones.
2 marls.
1 "Norfolk Fertilizer."
1 marine mud.
3 mucks.

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Of this number 34 were analyzed for private parties, and are only noticed in the following pages when the results are of general interest and value.

NATIVE PHOSPHATES.

Phosphate Rock, **708**. This sample, sent by H. H. Austin, Suffield, and reported to the Station as for sale by Horatio Lothrop of the same place, was analyzed with the following result:

Phosphoric acid,	37.84
Cost per ton,	$19.00

Cost of phosphoric acid per pound, 2½ cts.

The sample was very fine, all of it passing through a sieve having $\frac{1}{50}$ inch meshes. Prolonged treatment with ammonium citrate dissolved only 4½ per cent. of the phosphoric acid.

The phosphoric acid is therefore mostly "insoluble" but material as finely pulverized as this "Ground Phosphate Rock" might be often used to advantage where phosphates are deficient, especially on soils with abundant humus or decaying vegetable matter, as in case of reclaimed swamps, and where green-crops are plowed in, or on moist grass lands. At the price quoted it would also make a cheap and excellent superphosphate by treatment with oil of vitriol.

It was finally learned that this ground phosphate was not in the market, but was from a sample in the hands of an importer.

783. Phœnix Guano. Sold by W. C. Staples & Son, Westport. Sampled and sent by W. L. Coley, Westport.

ANALYSIS.

"Reverted" phosphoric acid,	16.52
Insoluble phosphoric acid,	6.52
Cost per ton,	$40.00
Estimated value per ton,	33.65

Phœnix Guano from McKean's Island, like the Baker and Jarvis Islands, Curaçao, Orchilla and other guanos from rainy regions, has lost by atmospheric agency all or all but a trace of the nitrogen and potash which it originally contained. The phosphoric acid in them is much more readily soluble than in the rock phosphates, and on that account they are more active as fertilizers when applied to the land without previous treatment with oil of vitriol. Sample **783** was from a small stock remaining in possession of the dealer. The importations of Phœnix Guano are understood to have ceased some years ago.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

Four articles of this class have been examined within the year. The analyses and valuations of three of them will be found on page 26.

These are superphosphates in the true sense of the term, for essentially all the phosphate of lime which they contain is soluble in water. In such cases it is of little importance to the purchaser whether the basis of the superphosphate is rock-phosphate or bone, while if, as is generally the case, from one-third to one-half or even more of the phosphoric acid in a superphosphate is insoluble, it will make a very considerable difference in the agricultural value of the article whether the insoluble portion consists of bone or rock. In many cases it is not easy for the chemist to decide with certainty what is the source of the phosphoric acid, and there is therefore wisdom and economy in providing soluble phosphoric acid in these high grade goods.

PLAIN SUPERPHOSPHATES.

735. Superphosphate of Lime, 19 per cent. From stock of H. J. Baker & Bro., N. Y. Sampled and sent by J. J. Webb, Hamden.

766. Acid Phosphate of Lime, 14 per cent. available phosphoric acid. H. J. Baker & Bro., N. Y., wholesale dealers. Sampled from stock of Wilson & Burr, Middletown, by J. M. Hubbard, Middletown.

779. Dissolved Bone. Made by William L. Bradley, Boston. Sold by H. D. Torrey, Putnam. Sampled and sent by W. I. Bartholomew, Putnam.

	735	766	779
Soluble phos. acid,	19.33	11.50	13.33
Reverted phos. acid,	.31	1.22	1.12
Insoluble phos. acid,	.35	.74	1.75
Cost per ton,	$34.50*	$27.00	$40.00
Cost of soluble phos. acid per 100 lbs.	$ 8.67†	$10.40	$13.46
	$ 8.92‡	$11.74	$15.00

* In New York.
† Reckoning reverted and insoluble at 9 and 6 cents per pound respectively.
‡ Making no allowance for reverted and insoluble.

735 contains a larger percentage of soluble phosphoric acid than any sample previously brought to the Station. Superphosphates are made containing 35 per cent. and over, but these are sold to manufacturers for use in mixed fertilizers, and have not found their way into our retail market.

The cost of soluble phosphoric acid per 100 pounds, making no allowance for the reverted and insoluble phosphoric acid is, in **735**,

$8.92, in **766**, $11.74, in **779**, $15.00. If reverted and insoluble phosphoric acid are valued at 9c. and 6c. per pound, the cost of soluble phosphoric acid will be $8.67, $10.40 and $13.46 per 100 pounds respectively. If we add $2.00 to the cost of **735**, to cover freight from New York, the hundred pounds of soluble phosphoric acid in it would cost $9.44 without taking account of the reverted and insoluble, or $9.18 making allowance for these.

It is evident, then, that soluble phosphoric acid can be bought without difficulty at retail for less than the present Station valuation, $12.50 per 100 pounds.

799 is a sample of "Dissolved Bone Black," containing originally not far from 15 per cent. of soluble phosphoric acid, which has been treated with lime to "revert" the phosphoric acid for a particular use. It was sent to the Station for examination by Prof. H. P. Armsby of the Storrs Agricultural School. The analysis is as follows:

Soluble phosphoric acid,	none
Reverted phosphoric acid,	10.14
Insoluble phosphoric acid,	.89

Wood ashes, leached or unleached, will revert superphosphates in the same way and the two should not be mixed if an application of soluble phosphate is desired.

In some sections of the country, purchasers much prefer to buy superphosphates which are dark colored or black. If there is any reason in such a whim it probably lies in the belief that such goods contain bone-black and that a superphosphate made from that material is more apt to be of high grade. The addition of a very little *lampblack* in the manufacture is a not uncommon practice, to gratify this prejudice.

NITROGENOUS, (AMMONIATED) SUPERPHOSPHATES AND GUANOS.

This class includes all those commercial fertilizers—excepting the Special Fertilizers or "Formulas" to be noticed further on,—which contain or are claimed to contain any considerable amount of soluble phosphoric acid together with nitrogen. Potash is also found in most of them. Forty-nine samples of these goods have been tested. Sixteen were for private parties. The results of the other thirty-three analyses will be found tabulated on pages 28 to 31. 18 are called by the manufacturers, "Phos-

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
752	A. A. Ammoniated Superphosphate of Lime.	H. J. Baker & Bro., New York.	Wilcox & Judd, Bristol.	S. R. Gridley, Bristol.
773	Americus Brand Ammoniated Bone Superphosphate.	Williams, Clark & Co., New York.	O. F. Strunz, Bristol.	" " "
791	Phosphate.	G. H. Harris & Son, Eagleville, Ct.	Manufacturers.	W. H. Barrows, Willimantic.
793	Americus Brand Ammoniated Bone Superphosphate.	Williams, Clark & Co.	F. Ellsworth, Hartford.	L. S. Wells, New Britain.
741	Animal Fertilizer.	L. B. Darling & Co., Pawtucket, R. I.	J. P. Barstow & Co., Norwich.	J. P. Barstow, Norwich.
792	Dry Ground Fish.	Quin. Fertilizer Co., N. London, Ct.	Olds & Whipple, Hartford.	Olin Wheeler, Buckland.
744	Ammoniated Bone Superphosphate.	E. Frank Coe, New York.	J. P. Barstow & Co., Norwich.	J. P. Barstow, Norwich.
720	Superphosphate of Lime.	Bosworth Bros., Putnam, Ct.	Bosworth Bros., Putnam.	James Allen, Putnam.
808	Americus Ammoniated Bone Superphosphate.	Williams, Clark & Co.	O. F. Strunz, Bristol.	Station Agent.
762	Fish and Potash (second grade).	Quinnipiac Fertilizer Co.	S. A. Weldon & Son, Bristol.	S. R. Gridley, Bristol.
726	Phosphate.	" " "	R. B. Bradley & Co., N. Haven.	Station Agent.
805	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro.	Wilcox & Judd, Bristol.	" "
725	Fish and Potash, Crossed Fish Brand.	Quinnipiac Fertilizer Co.	R. B. Bradley & Co., N. Haven.	" "
790	Phosphate.	Lombard & Matthewson, Warrenville, Ct.	Buck, Durkee & Stiles, Willimantic.	N. P. Perkins, Willimantic.
829	Fish and Potash.	Geo. W. Miles Co., Milford, Ct.	Olds & Whipple, Hartford.	Station Agent.

NITROGENOUS SUPERPHOSPHATES—CONTINUED.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
749	XL. Superphosphate.	Bradley Fertilizer Co., Boston.	H. K. Brainard, Thompsonville.	Station Agent.
729	Pelican Bone Phosphate.	H. J. Baker & Bro.	Dennis Fenn, Milford.	Dennis Fenn, Milford.
747	Fish and Potash (second grade).	Quinnipiac Fertilizer Co.	A. W. Allen, Jr., Thompsonville.	Station Agent.
831	Ammoniated Bone Superphosphate.	Russell Coe, Linden, N. J.	H. A. Stillman & Co., Hartford.	" "
802	Ammoniated Bone Superphosphate.	Preston & Sons, Greenpoint, L. I.	E. N. Pierce & Co., Plainville.	" "
795	Fish and Potash.	Bowker Fertilizer Co., New York and Boston.	W. F. Fuller, Suffield.	W. H. Pomeroy, Suffield.
757	Pelican Bone Phosphate.	H. J. Baker & Bro.	Wilcox & Judd, Coal and Lumber Co., Bristol.	S. R. Gridley.
827	Prepared Dry Fish.	Bowker Fertilizer Co.	Coburn & Gale, Hartford.	Station Agent.
724	Dry Ground Fish Guano.	Quinnipiac Fertilizer Co.	R. B. Bradley & Co., N. Haven.	" "
803	Dried and Ground Fish Guano.	Preston & Sons.	E. N. Pierce & Co., Plainville.	" "
832	Soluble Pacific Guano.	Pacific Guano Co., Boston, Mass.	H. A. Stillman & Co., Hartford.	" "
737	Fish and Potash, Crossed Fish Brand.	Quinnipiac Fertilizer Co.	A. W. Allen, Jr., Thompsonville.	C. T. Remington, Suffield.
730	A. A. Brand Phosphate.	H. J. Baker & Bro.	Dennis Fenn, Milford.	Dennis Fenn.
755	Brighton Phosphate.	Bowker Fertilizer Co.	S. A. Weldon & Son, Bristol.	S. R. Gridley.
750	Pine Island Guano.	Quinnipiac Fertilizer Co.	A. W. Allen, Jr., Thompsonville.	Station Agent.
833	I.X.L. Ammon'. Bone Superphos.	Geo. W. Miles Co.	Olds & Whipple, Hartford.	" "
828	Cooke's Blood Guano.	Bowker Fertilizer Co.	A. C. Sternberg, Hartford.	" "
763	Powell's Prepared Chemicals.	Brown Chemical Co., Baltimore.		S. R. Gridley.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
752	H. J. Baker & Bro's A. A. Ammoniated Superphosphate of Lime	--	--	3.29	8.44	1.45	.62	3.29	--	$50.23	$42.00	$8.23
773	Williams, Clark & Co's Americus Brand Ammoniated Bone Superphos.	--	--	2.90	10.82	.92	1.05	2.82	1.91	46.71	40.00	6.71
791	Geo. H. Harris & Son's Phosphate	--	--	3.08	4.43	6.26	3.81	.35	4.00	42.81	*37.00	5.81
793	Williams, Clark & Co's Americus Brand Ammoniated Bone Superphos.	--	--	2.81	9.13	1.02	.63	2.95	2.26	41.87	§38.00	3.87
741	Darling's Animal Fertilizer	--	--	4.20	.70	7.46	5.11	5.95	5.76	47.41	‡45.00	2.41
792	Quinnipiac Fertilizer Co's Dry Ground Fish	1.45	--	5.59	1.52	4.58	2.62	2.69	3.19	52.24	50.00	2.24
744	E. Frank Coe's Ammoniated Bone Superphosphate	--	--	2.63	8.11	1.34	2.80	--	--	38.67	37.00	1.67
720	Bosworth Bros' Superphosphate of Lime	--	--	2.10	5.50	4.61	4.17	2.23	--	39.36	*38.00	1.36
808	Williams, Clark & Co's Americus Brand Ammoniated Bone Superphos.	--	--	2.50	9.79	.71	.77	2.42	1.45	41.10	40.00	1.10
762	Quinnipiac Fertilizer Co's Fish and Potash (second grade)	.20	--	2.72	.27	4.83	4.96	4.75	6.60	33.17	33.00	.17
												Cost exceeds Valuation.
726	Quinnipiac Fertilizer Co's Phosphate	1.62	--	1.38	5.43	2.76	2.91	2.35	4.60	39.43	40.00	.57
805	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	--	1.16	1.51	8.30	1.58	.52	3.04	3.03	41.23	42.00	.77
725	Quinnipiac Fertilizer Co's Fish and Potash, Crossed Fish Brand	1.64	--	2.42	.80	3.17	4.13	4.19	8.61	37.00	38.00	1.00
790	Lombard & Matthewson's Phosphate	--	--	2.46	4.34	8.08	.69	.26	4.57	38.43	‖40.00	1.58
829	Geo. W. Miles Co's Fish and Potash	--	.46	3.43	4.08	1.24	1.86	4.31	4.25	38.10	40.00	1.90
749	Bradley Fertilizer Co's XL. Superphosphate	--	--	2.67	8.33	1.38	1.75	1.74	1.77	39.97	42.00	2.03

* In bulk. § In New York. ‡ Figured from cost per bag, viz: $3.75 for 167 lbs. ‖ In bags.

NITROGENOUS SUPERPHOSPHATES—CONTINUED.

Station No.	Name.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds Valuation.
729	H. J. Baker & Bro's Pelican Bone Phosphate	.94	--	1.48	6.35	2.21	.73	2.87	4.51	35.60	38.00	2.40
747	Quinnipiac Fertilizer Co's Fish and Potash (second grade)	--	--	2.84	.15	4.59	5.23	4.93	9.08	33.48	36.00	2.52
831	Russell Coe's Ammoniated Bone Superphosphate	--	--	2.10	8.08	1.88	1.82	1.41	2.48	37.25	40.00	2.75
802	Preston & Sons' Ammoniated Bone Superphosphate	--	--	2.36	7.06	1.79	3.53	--	--	36.44	40.00	3.56
795	Bowker Fertilizer Co's Fish and Potash	--	--	2.18	4.11	1.19	2.16	5.44	10.54	30.91	35.00	4.09
757	H. J. Baker & Bro's Pelican Bone Phosphate	.98	--	1.57	6.46	2.07	.63	2.32	3.93	35.60	40.00	4.40
827	Bowker Fertilizer Co's Prepared Dry Fish	--	--	3.75	1.05	5.85	3.67	--	--	35.56	40.00	4.44
724	Quinnipiac Fertilizer Co's Dry Ground Fish Guano	--	--	5.11	.48	5.18	4.16	2.50	5.15	43.54	48.00	4.46
803	Preston & Sons' Dried and Ground Fish Guano	.39	1.21	1.95	2.23	3.25	.52	--	--	30.46	35.00	4.54
832	Soluble Pacific Guano	.75	--	1.56	6.19	1.91	4.88	3.11	2.62	39.28	45.00	5.72
737	Quinnipiac Fertilizer Co's Fish and Potash. Crossed Fish Brand	.53	..	3.01	.43	4.06	3.58	3.97	8.15	33.87	40.00	6.23
730	H. J. Baker & Bro's A. A. Brand Phosphate	--	--	3.14	6.57	2.45	.55	2.15	2.22	38.71	45.00	6.29
755	Bowker Fertilizer Co's Brighton Phosphate	--	--	2.00	4.88	2.38	4.49	1.63	--	33.10	40.00	6.90
750	Quinnipiac Fertilizer Co's Pine Island Guano	1.80	--	2.72	1.64	3.95	3.90	3.41	--	42.08	50.00	7 92
833	Geo. W. Miles Co's I. X. L. Ammoniated Bone Superphosphate	-	..	1.70	7.71	.90	2.18	1.90	1.68	33.58	42.00	8.42
828	Bowker Fertilizer Co., Cooke's Blood Guano	--	--	1.88	4.11	2.83	4.26	1.54	2.42	31.04	42.50	11.46
763	Brown Chemical Co's Prepared Chemicals	--	--	1.76	3 83	.90	1.62	8.78	6.90	30.37	†46.15	15.78
	Average 32 Samples	--	--	--	--	--	--	--	--	38.69	40.58	----

† Figured from cost per bbl., viz: $6.00 for 260 lbs.

phates or Superphosphates," 6, "Fish and Potash," and 3 "Ground Fish Guano." The other six are "Prepared Dry Fish," "Soluble Pacific Guano," "Pine Island Guano," "Blood Guano," "Animal Fertilizer," and "Prepared Chemicals."

The last named, No. **763**, is advertised as follows:* "For $12 a farmer can buy a formula (520 lbs.) of POWELL'S PREPARED CHEMICALS. This, when mixed at home, makes one ton of SUPERIOR PHOSPHATE, equal in plant-life and as certain of successful crop-production as many high-priced phosphates." A device, resembling a trade mark, bears the words, "Purity." "Quality not quantity."

This is a superphosphate of rather low grade; its cost is $46.15 per ton and its estimated value $30.37. 520 lbs. of it "mixed at home" would require the addition of 1480 lbs. of something better than itself to make "one ton of superior phosphate." It was sampled by Mr. Gridley of Bristol from a lot purchased by a farmer in that place. We do not understand that the goods are at present offered for sale in this State.

It will be observed that during 1882 nitrates have been considerably used as a source of nitrogen both in the superphosphates and special manures. During the last 18 months the nitrogen of Chili saltpeter has ruled cheaper than that of dried blood, azotin, ammonite, fish scrap, etc., so that manufacturers have made use of it more frequently than in past years.

Chlorine has been determined in most cases in order to decide whether the potash in the fertilizer exists as muriate or sulphate. High grade sulphate contains none or only very little chlorine, the double sulphate of potash and magnesia, which has now come into considerable use in this country, has only from one to four per cent. of chlorine while muriate of potash (80 per cent.) has 38 or more per cent.

The table giving a Comparison of Different Fertilizers of the same Brand, p. 33, makes evident the variations which may arise from want of uniformity in the materials employed in the manufacture, accidents or carelessness in the preparation of the fertilizer, the storage of the goods, errors in sampling, etc., etc.

We are informed by the manufacturers that the regular price of the Quinnipiac Fertilizer Co's Fish and Potash No. 1, is $38.00, and that **737** (price $40.00) was from a special lot of which only two tons were made.

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* Cover of the American Agriculturist, Jan., 1882.

COMPARISON OF DIFFERENT SUPERPHOSPHATES OF THE SAME BRAND.

Station No.	Name or Brand.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.
752	H. J. Baker & Bro's Ammoniated Superphosphate			3.29	8.44	1.45	.62	3.29	
805			1.16	1.51	8.30	1.58	.52	3.04	3.03
730				3.14	6.57	2.45	.55	2.15	2.22
729	H. J. Baker & Bro's Pelican Bone Phosphate	.94		1.48	6.35	2.21	.73	2.87	4.51
757		.98		1.57	6.46	2.07	.63	2.32	3.93
792	Quinnipiac Fertilizer Co's Dry Ground Fish Guano	1.45		5.59	1.52	4.58	2.62	2.69	3.19
724				5.11	.48	5.18	4.16	2.50	5.15
725	Quin. Fertilizer Co's Fish and Potash, Crossed Fish Brand	1.64		2.42	.80	3.17	4.13	4.19	8.61
787		.53		3.01	.43	4.06	3.58	3.97	8.15
762	Quinnipiac Fertilizer Co's Fish and Potash, Second Grade	.20		2.72	.27	4.83	4.96	4.75	6.60
747				2.84	.15	4.59	5.23	4.93	9.08

SPECIAL FERTILIZERS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
820	Corn Manure.	Geo. B. Forrester, New York.	--------------------------	S. B. Wakeman, Saugatuck.
821	Onion "	" " "	--------------------------	" " "
789	Corn "	Mapes' F. & P. G. Co., New York.	Mapes' F.& P.G.Co's Br'ch, Hart.	C. H. Pease, South Windsor.
767	Tobacco " (for use with stems).	" " " "	P. M. Augur & Sons, Middlefield.	J. M. Hubbard, Middletown.
787	" " " "	" " " "	Mapes Co's Branch, Hartford.	C. H. Pease.
815	Corn "	" " " "	P. M. Augur & Sons.	P. M. Augur.
822	Potato "	Geo. B. Forrester.	--------------------------	S. B. Wakeman.
816	Orange Tree Manure.	Mapes' F. & P. G. Co.	P. M. Augur & Sons.	P. M. Augur.
788	Tobacco Manure, Connecticut Brand.	" " "	Mapes Co's Branch, Hartford.	C. H. Pease.
760	Corn Manure.	H. J. Baker & Bro., New York.	Wilcox & Judd, Bristol.	S. R. Gridley.
782	Complete Corn Manure.	" " " "	Olds & Whipple, Hartford.	Olin Wheeler, Buckland.
814	Potato Manure.	Mapes' F. & P. G. Co.	P. M. Augur & Sons.	P. M. Augur.
807	" "	H. J. Baker & Bro.	Wilcox & Judd, Bristol.	Station Agent.
806	Corn "	" " "	" " "	" "
761	Stockbridge Manure for Corn & Grain.	Bowker Fertilizer Co.	S. A. Weldon & Son, Bristol.	S. R. Gridley, Bristol.
738	" Grass, Top Dressing.	" " "	J. P. Barstow & Co., Norwich.	J. P. Barstow, Norwich.
756	" Man. for Pot. and Veg.	" " "	S. A. Weldon & Son, Bristol.	S. R. Gridley.
810	" Manure for Grain.	" " "	" " " "	Station Agent.
781	Potato Manure.	H. J. Baker & Bro.	Olds & Whipple, Hartford.	J. F. Phelps, Bloomfield.
780	Complete Tobacco Manure.	" " "	" " "	Olin Wheeler.
740	Stockbridge Man. for Pot. and Veg.	Bowker Fertilizer Co.	J. P. Barstow & Co., Norwich.	J. P. Barstow.
739	" Man. for Corn and Grain.	" " "	" " " "	" "
830	Patent Fertilizer for Tobacco.	Bradley Fertilizer Co., Boston.	A. O. Sternberg, Hartford.	Station Agent.

SPECIAL FERTILIZERS.

Station No.	Name.	Nitrogen of Nitrates.	Nitrog. of Ammonia Salts.	Nitrog. of Organic Matters	Total Nitrogen.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
820	Corn Manure, Forrester's	....	5.09	.21	5.30	6.94	.84	.78	8.06	6.39	$58.39	*50.00	$8.39
821	Onion " "	....	5.53	....	5.53	5.93	.30	.40	5.69	.66	55.53	*50.00	5.53
789	Corn " Mapes'	1.00	2.36	.17	3.53	7.88	3.78	1.25	7.17	6.29	54.86	50.00	4.86
767	Tobacco " (for use with stems), Mapes'	2.60	2.35	.91	5.86	3.40	4.12	2.30	4.36	1.24	56.30	54.00	2.30
787	" " " " "	2.48	2.46	.66	5.60	4.76	2.77	2.14	4.37	.28	55.92	54.00	1.92
815	Corn " Mapes'	1.44	1.71	.87	4.02	4.93	4.67	2.15	6.91	7.45	51.82	50.00	1.82
822	Potato " Forrester's	....	3.78	....	3.78	5.98	.93	.31	10.27	4.90	50.69	50.00	.69
													Cost exceeds Valuation.
816	Orange Tree Manure, Mapes'	2.22	....	1.18	3.40	2.85	4.60	2.53	3.77	1.14	40.93	42.00	1.07
788	Tobacco Manure, Conn. Brand, Mapes'	1.52	1.68	.42	3.62	5.44	2.33	1.64	9.03	1.72	52.05	54.00	1.95
760	Corn Manure, Baker's	....	....	4.95	4.95	4.54	.89	.19	9.51	....	46.45	50.00	3.55
782	" "	1.66	1.96	.83	4.45	5.34	.31	.20	7.95	5.61	46.08	50.00	3.92
814	Potato Manure, Mapes'	1.46	1.30	1.18	3.94	3.25	4.61	2.18	6.10	4.88	45.94	51.00	5.06
807	" " Baker's	....	3.00	1.15	4.15	4.88	.14	.10	9.37	12.15	44.86	50.00	5.14
806	Corn " "	1.62	1.93	.61	4.16	4.42	1.34	.43	7.97	9.68	44.49	50.00	5.51
761	Corn and Grain Manure, Stockbridge	1.35	....	2.49	3.84	5.02	1.35	2.76	6.64	6.02	43.90	50.00	6.10
738	Grass Top Dressing, "	1.59	....	2.46	4.05	6.10	.62	2.77	3.69	3.14	43.46	50.00	6.54
756	Potato and Vegetable Manure, Stockbridge	.88	....	2.67	3.55	5.40	1.95	2.65	4.85	5.03	42.44	50.00	7.56
810	Grain Manure, Stockbridge	1.05	.13	2.30	3.48	4.85	1.72	2.57	6.83	6.62	42.39	50.00	7.61
781	Potato " Baker's	....	2.61	.96	3.57	4.66	.22	.05	9.99	11.13	41.87	50.00	8.13
780	Complete Tobacco Manure, Baker's	1.09	3.30	.35	4.76	2.48	.18	.02	8.56	9.98	41.60	50.00	8.40
740	Potato and Vegetable Manure, Stockbridge	.70	....	2.56	3.26	6.02	1.58	2.31	4.95	4.62	41.54	50.00	8.46
739	Corn and Grain " "	.67	....	3.15	3.82	6.29	1.12	1.03	3.87	3.53	41.46	50.00	8.54
830	Patent Fertilizer for Tobacco, Bradley's	.56	....	2.08	2.64	7.00	1.31	1.51	1.90	2.11	36.46	50.00	13.54
	Average 23 Analyses	....	....	....	....	....	....	....	....	....	46.93	50.22	....

* In New York.

Rejecting **763**, the average estimated value of the other 32 nitrogenous superphosphates this year has been $38.69 and the average cost $40.58; a difference in round numbers of $2.00.

In 1881 the average cost, $43.00, exceeded the average estimated value by $4.00, and in 1880 the average cost was $39.00, $3.00 more than the estimated value.

SPECIAL FERTILIZERS OR "FORMULAS."

On pages 34 and 35 will be found the analyses and valuations of 23 samples of these fertilizers. In 10 of the number nitrogen is present in three forms, as nitrates, ammonia, and in animal or vegetable matter ("organic nitrogen.")

In Mapes' Tobacco manures, (Connecticut brand, and for use with stems) Nos. 767, 787, and 788 and in Forrester's Onion Manure No. 821, most of the potash is present as sulphate.

The estimated value of two articles of this class is very considerably higher than their market price, in nine of them estimated value and cost differ less than $5.00, while in the remaining 12 the cost is a good deal higher than the estimated value.

The *average* cost is $50.22; $3.29 more than the average estimated value $46.93. In 1881 the average cost $48.40 exceeded the estimated value by $4.80, and in 1880 the average cost, $48.00, exceeded the estimated value by $3.35.

On the following page is a comparison of the various corn, tobacco and potato manures.

The average composition of these manures is as follows:

	Nitrogen.	Phosphoric Acid.	Potash.
Corn manure,	4.32	8.93	7.34
Tobacco manure,	3.67	7.30	6.49
Potato manure,	3.74	8.06	6.37

The tobacco and potato manures—on the average—agree in composition more closely than separate analyses of the same brand of goods usually do.

An examination of these analyses and those of special fertilizers made in past years, abundantly justifies the conclusion that on the farms of this State it is quite as rational to use a "Corn manure" on potato land or a "potato manure" for the tobacco crop, as in any other way. To attempt to construct a fertilizer specially adapted to growing a particular crop on soils which differ so widely in composition and have been so differently fertilized and tilled as those of Connecticut is irrational and useless. Objection to these goods only applies to their names and to the theory on which they are made and on which their special claims rest. As *fertilizers* they are of good quality; their higher retail price, compared with that of other superphosphates is in part justified by the larger amounts of nitrogen and potash which they usually contain.

COMPARISON OF SPECIAL MANURES.

Brand.		Total Nitrogen.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash	Chlorine.
Corn Manure	Forrester's, 1 Analysis	5.30	6.94	.84	.78	8.06	6.39
	Mapes', 2 Analyses	3.77	6.40	4.23	1.70	7.04	6.87
	Baker's, 3 "	4.52	4.77	.85	.27	8.48	7.64
	Stockbridge, 3 "	3.71	5.39	1.43	2.12	5.78	5.39
Tobacco Manure	Mapes', 1 Analysis	3.62	5.44	2.33	1.64	9.03	1.72
	Baker's, 1 "	4.76	2.48	.18	.02	8.56	9.98
	Bradley's, 1 "	2.64	7.00	1.31	1.51	1.90	2.11
Potato Manure	Forrester's, 1 Analysis	3.78	5.98	.93	.31	10.27	4.90
	Mapes', 1 "	3.94	3.25	4.61	2.18	6.10	4.88
	Baker's, 2 Analyses	3.86	4.77	.18	.07	9.68	11.64
	Stockbridge, 2 "	3.40	5.71	1.76	2.48	4.90	4.82

BONE MANURES.

Method of Valuation.

For the benefit of those who have not the previous reports of the Station at hand, a detailed account of the method employed for the valuation of bone manures is here given, being in large part reproduced from former Reports.

Experience has led us to distinguish, for the purpose of valuation, five grades of ground bone, the proportions of which are found by a mechanical analysis, *i. e.*, by passing a weighed sample of the bone through a system of four sieves. These five grades have the dimensions, and during 1882, have had the trade-values below specified, viz:

Grade.	Dimensions.	1882. Estimated value per pound. Nitrogen.	Phos. Acid.
Fine,	smaller than one 1/50 inch,	17 cts.	6 cts.
Fine medium,	between 1/50 and 1/25 inch,	15 "	5½ "
Medium,	" 1/25 and 1/12 inch,	14 "	5 "
Coarse medium,	" 1/12 and 1/6 inch,	13 "	4½ "
Coarse,	larger than 1/6 inch,	11 "	4 "

The chemical and mechanical analysis of a sample of ground bone being before us, we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone.

The following example will serve for illustration. Rogers and Hubbard's Pure Ground Bone, **818**, contains nitrogen 3.94 per cent., or 78.8 pounds per ton; phosphoric acid 22.50 per cent., or 450 pounds per ton. The mechanical analysis showed:

31 per cent. fine.
25 " fine medium.
23 " medium.
21 " coarse medium.
0 " coarse.
100

The calculations are as follows:

$78.8 \times 31 \div 100 \times 17 = \$4.16$
$78.8 \times 25 \div 100 \times 15 = 2.96$
$78.8 \times 23 \div 100 \times 14 = 2.54$
$78.8 \times 21 \div 100 \times 13 = 2.15$

Estimated value of nitrogen, $11.81

$450 \times 31 \div 100 \times 6 = \$8.37$
$450 \times 25 \div 100 \times 5\frac{1}{2} = 6.19$
$450 \times 23 \div 100 \times 5 = 5.18$
$450 \times 21 \div 100 \times 4\frac{1}{2} = 4.25$

Estimated value of phosphoric acid, $23.99

$35.80

The result agrees with the cost ($35.00) within 80 cents.

When the sample of bone contains foreign matters introduced as preservatives, dryers or adulterants, such as salt, salt-cake, niter-cake, ground oyster-shells, spent lime, plaster, or soil, these must be taken account of in the mechanical analysis, especially since they would be likely, on sifting, to pass chiefly or entirely into the finer grades. In such cases, the several grades as obtained by sifting must be separately examined, and the amounts of foreign matter which they contain must be suitably taken into the account if an *exact* valuation is desired.

In some instances a further source of error in valuation may arise from the fact that the proportions of nitrogen and phosphoric acid are not the same in the finer and coarser portions of a sample, which contains no adulterants, properly speaking, but partly consists of meat, tendon, etc.

There is, however, a limit beyond which it is useless to attempt to refine the processes of valuation. When they become too complicated or costly they defeat the object which they should serve. It is sufficient that the errors of valuation are no greater than those which arise from unavoidable variations in different portions of the same lot of fertilizer, or in different lots of the same brand. A difference of two or three dollars between cost and estimated value cannot ordinarily demonstrate that either is out of the way.

BONE MANURES.

Analyses.

[See pages 40 and 41.]

Sample **733** was very wet, which accounts for the low percentage of nitrogen and phosphoric acid found in it. At the price asked ($25.00 per ton) it is an excellent article for immediate use, but in its moist state could not be kept long without decomposition and loss.

In five of the samples analyzed this year the valuations fall very considerably below the market price. In **731** and **804** this is caused chiefly by the coarseness of the bone. **770** contains salt-cake in considerable quantity, as this brand of goods usually does. **801** probably contains the same. **751** has 6.9 per cent. of sulphuric acid combined with lime, being equivalent to 13.3 per cent. of hydrated plaster.

Salt-cake is used as a drier and preservative to mix with bone which would otherwise be too wet to handle and transport. No secret is made of it by the manufacturers, nor is the mixture sold as "pure" bone. But bone sold as "pure" which contains 13 per cent. of land plaster has clearly been adulterated.

The average cost of bone this year, $35.29, exceeds the average estimated value, $32.14, by $3.15.

BONE MANURES—ANALYSES AND VALUATIONS.

Station No.	Name.	Nitrogen.	Phos. Acid.	Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Finer than 1/6 inch.	Coarser than 1/6 inch.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
711	Bone Sawings	3.86	26.98	97	3	----	----	----	$45.37	*40.00	$5.37
764	Williams, Clark & Co's Bone Meal	3.76	21.22	61	22	15	2	----	36.28	32.00	4.28
733	Rogers & Hubbard Co's Bone Sawings	2.10	16.50	100	----	----	----	----	26.94	25.00	1.94
732	" " " " Meal	3.94	23.66	40	35	25	----	----	38.63	37.50	1.13
771	Mapes' Extra Fine, Strictly Pure Ground Bone	2.49	28.87	52	40	8	----	----	40.98	40.00	.98
818	Rogers & Hubbard Co's Pure Ground Bone, Grade AX	3.94	22.50	31	25	23	21	----	35.80	35.00	.80
											Cost exceeds Valuation.
§677	Peck Brothers' Ground Bone	4.32	21.89	7	14	17	33	29	31.95	32.00	----
824	Geo. B. Forrester's Pure Ground Bone	3.40	21.95	42	19	21	16	2	34.13	†36.00	1.87
794	Williams, Clark & Co's Americus Bone Meal	3.14	22.54	59	18	16	7	----	35.43	†38.00	2.57
743	Rogers & Hubbard Co's "A" Bone	3.94	24.47	10	13	31	46	----	35.16	38.00	2.84
742	Darling's Fine Bone	3.82	22.71	73	21	6	----	----	39.02	42.00	2.98
839	Richards' Pure Bone	4.08	20.55	14	21	24	31	10	31.94	35.00	3.06
753	Peck Brothers' Ground Bone	4.04	21.77	6	9	30	46	9	31.77	35.00	3.23
770	Lister Brothers' Celebrated Ground Bone	3.22	14.48	42	19	14	14	11	25.10	31.00	5.90
731	H. J. Baker & Bro's Pure Ground Bone	3.65	23.83	10	16	35	38	1	33.99	40.00	6.01
804	Richardson's Ground Bone	3.54	16.35	6	20	29	29	16	25.51	33.00	7.49
751	Pure Ground Bone	2.84	14.33	41	23	23	10	3	24.27	34.00	9.73
§670	Rafferty & Williams' Bone Meal	1.68	14.36	52	20	14	14	----	21.19	32.00	----
801	Preston & Sons' Ground Bone	1.94	10.47	43	21	15	12	9	17.12	35.00	17.88
817	Rogers & Hubbard Co's Marine Bone	4.61	22.89	33	55	12	----	----	39.99	‡	----
	Average 19 Analyses	----	----	----	----	----	----	----	32.14	35.29	----

§ The analyses of **670** and **677**, made late in 1881, were in the last Station Report, with valuations reckoned from the trade values adopted for last year. The advance in cost of nitrogenous raw-materials having necessitated changes in the Station scale of trade values, these analyses are here given with valuations calculated by the trade-values of 1882.

* In bbls. net. † In New York. ‡ Price not fixed.

BONE MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
711	Bone Sawings.	------------------------------	Wilder & Puffer, Springfield.	R. E. Pinney, Suffield, Ct.
764	Bone Meal.	Williams, Clark & Co., New York.	S. A. Weldon & Son, Bristol.	S. R. Gridley, Bristol.
733	Bone Sawings.	Rogers & Hubbard Co., Middleto'n	Manufacturers.	P. M. Augur, Middlefield, Ct.
732	Bone Meal.	" " " "	"	" " " "
771	Extra Fine, Strictly Pure Ground Bone.	Mapes' Formula and Peruvian Guano Co., New York.	W. H. Smith, Norwalk, Ct.	D. H. Van Hoosear, Wilton, Ct.
818	Pure Ground Bone, Grade AX.	Rogers & Hubbard Co.	Manufacturers.	Chas. Fairchild, Middletown, Ct.
677	Ground Bone.	Peck Bros., Northfield, Ct.	G. P. Burnett, Bristol.	S. R. Gridley, Nov. 9, 1881.
824	Pure Ground Bone.	Geo. B. Forrester, New York.	------------------------------	S. B. Wakeman, Saugatuck, Ct.
794	Americus Bone Meal.	Williams, Clark & Co.	F. Ellsworth, Hartford, Ct.	L. S. Wells, New Britain, Ct.
743	"A" Bone.	Rogers & Hubbard Co.	------------------------------	J. P. Barstow, Norwich, Ct.
742	Darling's Fine Bone.	L. B. Darling & Co., Pawtucket, R. I.	J. P. Barstow & Co., Norwich.	" " " "
839	Richards' Pure Bone.	Geo. Richards & Co., Unionville.	Manufacturers.	Wm. Porter, Unionville.
753	Ground Bone.	Peck Bros., Northfield.	G. Perry Bennett, Bristol, Ct.	S. R. Gridley.
770	Celebrated Ground Bone.	Lister Bros., Newark, N. J.	Manufacturers.	D. H. Van Hoosear, Wilton.
731	Pure Ground Bone.	H. J. Baker & Bro., New York.	Dennis Fenn, Milford.	Dennis Fenn.
804	Ground Bone.	Geo. Richardson & Son, Unionville	E. N. Pierce & Co., Plainville.	Station Agent.
751	Pure Ground Bone.	------------------------------	H. K. Brainard, Thompsonville.	" "
670	Bone Meal.	Rafferty & Williams, New York.	S. A. Weldon & Son, Bristol.	S. R. Gridley, Oct. 6, 1881.
801	Ground Bone.	Preston & Sons, Greenpoint, L. I.	E. N. Pierce & Co., Plainville.	Station Agent.
817	Marine Bone.	Rogers & Hubbard Co.	Manufacturers.	Chas. Fairchild.

Dry Ground Fish.

During the year no samples of this fertilizer have been sent to the Station by purchasers or dealers. The two examinations made, were partial analyses for private parties.

Nitrates of Potash and Soda.

837. Saltpeter. From stock of E. B. Botchford, New Milford.

838. Nitrate of Soda. From stock of Merritt Beach, New Milford.

837 and **838** were sampled and sent by J. M. Hallock, Gaylordsville.

811. "Saltpeter." Sold by Martin Hungerford, Gaylordsville. Sampled and sent June 19, by G. N. Woodruff, Sherman. No printed analysis or statement of composition was attached to the barrels or accompanied the goods, which were sold under verbal guarantee that they contained 95 per cent. saltpeter.

812. "Saltpeter." Sold by M. L. Hungerford, Gaylord's Bridge. Sampled and sent June 20th, by A. G. Barnes, New Milford. No guarantee upon the barrel. Stated to be pure saltpeter, such as is used in the manufacture of powder.

813. "Saltpeter." Sampled and sent June 19th, by H. T. Haviland, Sherman.

The results of the analyses of **811**, **812** and **813** were reported to Messrs. Woodruff, Barnes and Haviland, June 30th. In a few days after came to hand—

819. "Saltpeter." Sold by M. L. Hungerford. Sampled and sent July 3d, by Geo. G. Hungerford, Gaylordsville. "Name and address of manufacturer not known."

This last sample contained besides the rhombohedral crystals of soda-saltpeter with nearly square faces, a number of long prismatic crystals of common or potash saltpeter.

Analyses and Valuations.

	837	838	811	812	813	819
Nitrogen in nitrates	12.98	14.29	6.24	5.53	7.12	10.76
Potash	44.65	----	none	none	none	13.38
Magnesia	----	.86	----	----	----	----
Chlorine	2.06	2.66	38.11	39.47	33.70	17.83
Water	1.12	3.78	----	----	---	----

The composition of these articles, as deduced from the above analytical determinations, may be represented as follows:

	837	838	811	812	813	819
Sodium nitrate (soda-saltpeter)	----	86.76	37.89	33.57	43.23	41.22
Potassium nitrate (potash-saltpeter)	93.78	----	none	none	none	28.72
Sodium chloride (common salt)	2.24	4.38	62.11	65.05	55.51	29.38
Potassium chloride	1.47	----	----	----	----	----
Magnesium sulphate	----	2.59	----	----	----	----
Water	1.12	3.78	----	-- .	----	----
Other matters, not determined	1.39	2.49	----	1.38	1.26	.68
	100.00	100.00	100.00	100.00	100.00	100.00
Commercial value of nitrogen* per ton	$67.50	74.31	32.45	28.75	37.02	55.95
" " " potash† "	$62.51	----	----	----	----	18.73
" " " salt‡ "	----	----	$6.70	7.00	6.00	3.25
Estimated value per ton	$130.01	74.31	39.15	35.75	43.02	77.93
Cost per ton	** $600.00	** 100.00	†† 130.00	†† 130.00	not stated	†† 130.00

* Reckoned from the Station price of nitrogen in nitrates, viz: 26 cents per lb.]

† Potash is valued at 7 cents per lb.

‡ Assuming agricultural salt, containing 94 per cent. sodium chloride, to cost $10.00 per ton. See Station Report for 1881, p. 53.

** Reckoned from price per cwt.

†† Reckoned from price per pound, 6½ cents.

The term "saltpeter" properly refers to nitrate of potash which in its pure state contains 53.4 per cent. of potash and 46.6 per cent. of nitric acid, the latter equivalent to (containing) 13.84 per cent. of nitrogen. **837** is the commercial article of fair quality. Refined saltpeter is now quoted at from 7 to 9 cts. per lb. and can be bought in New York for that price in 100 lb. packages. At that price saltpeter can be obtained by consumers in New Milford for from $140. to $180 per ton with the cost of freight from New York added. Nitrate of Soda, also called "cubic niter," or "Chili saltpeter" contains in the pure state 36.5 per cent. of soda and 63.5 per cent. of nitric acid, the latter equivalent to 16.46 per cent. of nitrogen. The commercial article usually contains 95 per cent. of pure nitrate of soda, from 1 to 3 per cent. of moisture, besides a little chloride of sodium (salt) and dirt. **838** is nitrate of soda of rather poor quality; containing 2.6 per cent. of Epsom salts and rather more salt and dirt than first rate goods do. 95 per cent. nitrate of soda has retailed in the New York and Philadelphia markets this year at about $76.50 per ton. In some cases as low as $67.50.

The samples sent from Sherman and New Milford, as "pure saltpeter, such as is used in the manufacture of powder," **811, 812** and **813**, are variable mixtures of soda-saltpeter (Chili saltpeter) with common salt, the latter predominating, and contain no potash at all, while as said before such saltpeter as is used in making gunpowder contains 46.6 per cent. of potash. Pure potash-saltpeter by the Station valuation for 1882 has an estimated value of $136.00 per ton. These "saltpeters" are worth commercially but $43, $39 and $35.75 respectively, and not only are destitute of potash, an essential ingredient of that saltpeter which it is claimed they were represented to be, but they contain 56 to 65 per cent. of common salt, which is not, in general, a benefit to land or crops, even when applied cautiously and in small quantity, and is often an injury, especially on tobacco, the burning quality of which it is believed to impair very seriously.

The last sample, **819**, contains a considerable proportion of potash-saltpeter, and has about double the money-worth of the others, yet nearly 30 per cent. of it is common salt and its cost exceeds its value by more than fifty dollars per ton.

SULPHATE OF AMMONIA.

One sample of this article has been examined the past year with the following result:

778. Sulphate of Ammonia from the Bradley Fertilizer Co., Boston, Mass.; sold by H. D. Torrey, Putnam; sampled and sent by W. L Bartholomew, Putnam.

ANALYSIS.

Nitrogen,	20.56
Equivalent Sulphate of Ammonia,	96.90
Cost per 100 lbs.,	$ 6.00
Cost of nitrogen per 100 lbs.,	$29.11

The quality of this article is unexceptionable. Inferior grades of "Sulphate of Ammonia" sometimes come into the market, which contain a part of their nitrogen in the form of cyanides and sulpho-cyanides of ammonium, and are therefore poisonous and destructive to vegetation.

DRIED BLOOD AND TANKAGE.

Four analyses of these materials have been made for private parties, and the results are here given with the other analyses made for purchasers. **736.** Dried Blood, made by Sperry & Barnes, New Haven; sent by J. J. Webb, Hamden. **768.** Tankage, made by Strong, Barnes, Hart & Co., New Haven; sent by J. M. Hubbard, Middletown. **702, 703** and **704** are samples of comparatively pure dried blood containing very little bone. "Tankage" is a mixture of blood and offal of various sorts with fragments of bone. It contains less nitrogen, more phosphoric acid and usually more moisture than the pure dried blood. **736, 768** and **784** are all articles of this class.

ANALYSES.

	736	768	784	702	703	704
Nitrogen,	7.43	6.99	6.96	11.08	10.08	10.01
Equivalent ammonia,	9.02	8.49	8.45	13.45	12.24	12.15
Phosphoric acid,	7.46	6.90	4.14			
Moisture,			30.26	9.27	18.99	19.00
Estimated value per ton,	$44.61	41.83				
Cost per ton,	$35.00	35.00				

Allowing 6 cents per pound for the phosphoric acid in **736** and **768,** the nitrogen costs 18 cents in one and 19 in the other. No other fertilizers examined this year furnish nitrogen in so cheap and readily assimilable a form.

COTTON SEED AND CASTOR POMACE.

Analyses and Valuations.

706. Castor Pomace, manufactured by H. Mayhew & Son, Fort Scott, Kansas. Sampled and sent by E. F. Collins, Somers. Not finely ground.

723. I.X.L. Castor Pomace, manufactured by R. B. Brown & Co., St. Louis. Sampled and sent by A. P. Hills, East Hartford.

746. Jersey Castor Pomace, manufacturer not known. Sampled from stock of A. W. Allen, Jr., Thompsonville, by the Station Agent.

748. Cotton Seed Meal. Sampled from stock of H. K. Brainard, Thompsonville, by the Station Agent.

ANALYSES AND VALUATIONS.

	706	723	746	748
Nitrogen,	5.01	5.73	4.95	6.55
Phosphoric acid,	1.89	2.06	1.55	3.52
Potash,	0.94	1.19	1.08	2.05
Cost per ton,	Not given.	$30.00	32.00	29.00
Estimated value per ton,	$21.25	24.29	20.74	29.85

723 appears to contain a large admixture of Cotton Seed Meal, to which its greater content of nitrogen is due.

Some tobacco growers believe that Castor Pomace has a particularly favorable effect on the quality of the tobacco leaf, which cannot be produced by other nitrogenous manures, and therefore prefer to pay a special price for nitrogen in this form. The Station valuations, however, as is abundantly explained elsewhere, do not and are not designed to indicate the *agricultural* value of fertilizers, but represent the average market prices of their different ingredients.

FOWL MANURE.

A sample of this material, **684**, sold by Horatio Lothrop, Suffield, and sent by H. H. Austin, Suffield, has the following composition:

Nitrogen,	3.25
Insoluble in acid (sand and soil),	38.20
Potash,	1.12
Phosphoric acid,	2.83
Estimated value per ton,	$19.43
Cost,	$27.00

The fowl manure was quite dry. It contained a considerable quantity of feathers. In it nitrogen is valued at 20 cents, phosphoric acid at 9 cents, and potash at 6 cents.

TRIPE REFUSE.

701. Refuse from Tripe Factory, composted with earth. Sent by Newton Brothers, 341 Asylum St., Hartford.

ANALYSIS.

Nitrogen,	2.20
Phosphoric acid,	2.91
Sand and soil,	3.49
Estimated value,	$9.51
Cost per ton,	not known.

The Tripe refuse contained about 60 per cent. of moisture, and on burning left 9 per cent. of ash, of which 5.5 per cent. was soluble in dilute acid and consisted chiefly of bone-ash (phosphate of lime). The sample was accordingly nearly free from "earth." Its nitrogen is valued at 15 cents, its phosphoric acid at 5 cents. Its mechanical condition was coarse.

DAMAGED TEA.

705. Sold by H. J. Baker & Bro., New York; sent by Edwin Hoyt, New Canaan.

ANALYSIS.

Nitrogen,	2.04
Ash,	11.99
Water,	54.44

POTASH SALTS.

On pages 48 and 49 are tabulated the analyses and valuations of 9 fertilizers belonging in this class. Five of them are high grade muriates, three double sulphates of potash and magnesia and one kainite.

798 was stated to have been taken from a bag, also sent, on which, besides one word too indistinct to make out, the following was printed:

"Actual Sulphate of Potash. Patented by Dr. F. Dupre and C. H. Hake, Germany and America. Manufactured by the Stassfurter Chemische Fabrik, Stassfurt. J. H. Salmon, New York, Agent.

From the analytical results the following composition is calculated for **775** and **798**:

	775	**798**
Sulphate of potash,	47.82	45.85
" magnesia,	35.79	39.03
Soda, chlorine, water, &c.,	16.39	15.12
	100.00	100.00

Sulphate of magnesia is now offered for agricultural use in "Kieserite" which contains about 80 per cent. and is quoted at $4.50 to $5.25 per ton wholesale. Adding to the highest of these figures 20 per cent., we have $6.30 as a fair retail price. The samples **775** and **798** which contain 36 to 40 per cent. of sulphate of magnesia have, accordingly, about $3.00 worth of that sub-

POTASH SALTS.

Station No.	Name.	Importer.	Dealer.	Sampled and Sent by
728	Muriate of Potash, 80–84 per cent.	H. J. Baker & Bro., New York.	Dennis Fenn, Milford.	Dennis Fenn.
734	" " 80 "	" " " "	------------------------	J. J. Webb, Hamden.
769	" " 80 "	" " " "	Wilson & Burr, Middletown.	J. M. Hubbard, Middletown.
765	" " 80 "	------------------------	S. J. Hall, Meriden.	Oliver Rice, Meriden.
777	" "	Wm. L. Bradley, Boston, Mass.	H. D. Torrey, Putnam.	W. I. Bartholomew, Putnam.
823	Sulphate of Potash.	------------------------	Geo. B. Forrester, New York.	S. B. Wakeman, Saugatuck.
809	Acorn Brand German Potash Salts.	Williams, Clark & Co., New York.	O. F. Strunz, Bristol.	Station Agent.
775	Double Sulphate of Potash and Magnesia.	------------------------	H. J. Lathrop, Suffield.	W. F. Fuller, Suffield.
798	Actual Sulphate of Potash.	------------------------	------------------------	J. H. Lathrop, Suffield.

Analyses.

	728	784	769	765	777	828	809	775	798
Potash (potassium oxide)	55.25	50.23	51.21	52.13	54.14	24.20	11.63	25.86	24.80
Equivalent to pure muriate	86.81	79.02	80.56	82.57	85.70	----	----	----	----
" " " sulphate	----	----	----	----	----	44.82	21.50	47.82	45.85
Magnesia	----	----	----	----	----	----	----	11.93	13.01
Chlorine	----	----	----	----	----	2.20	25.07	.90	3.93
Potash guaranteed or implied in brand	50	50	50	50	----	----	----	----	----
Muriate guaranteed	80	80	80	80	----	----	----	----	----
Sulphate guaranteed	----	----	----	----	----	----	22	----	----
Cost per ton	$50.00	*40.00	42.50	45.00	**60.00	†37.57	15.00	38.00	35.00
Estimated value per ton	----	----	----	----	----	33.88	11.63	----	----
Cost per 100 lbs. of potash	$4.53	3.98	4.15	4.31	5.54	7.76	6.44	‡7.34	‡7.05

* In New York. ** Reckoned from price per 100 lbs. † Reckoned from price of bbl., 346 lbs., net.
‡ Making no allowance for sulphate of magnesia.

stance per ton: allowing for it, 100 pounds of potash in **775** cost $6.77 and in **798** cost $6.45.

The analyses show that the two brands "Double Sulphate of Potash and Magnesia," and "Actual Sulphate of Potash," are practically the same thing.

In the high grade muriate, actual potash has cost at retail from 4 to 5½ cents a pound; on the average 4½ cents, or half a cent a pound less than is credited for it in the Station valuation.

LAND PLASTER.

834. Cayuga Plaster, sent by P. M. Augur & Sons, Middlefield.

ANALYSIS.

Hydrated sulphate of lime or plaster,	68.71
Insoluble in acid,	7.50
Carbonates,	23.79
	100.00
Cost per ton,	$6.00

The Land Plaster from New York State, Onondaga and Cayuga plaster, contains usually from 65 to 75 per cent. of hydrated plaster, 6–8 per cent. of insoluble matter, besides from 18 to 28 per cent. of carbonate of lime.

Nova Scotia plaster has on the average 94 per cent. of hydrated plaster, 2 per cent. of insoluble matter and 4 per cent. of carbonates.

LIME.

796. Fertilizer Lime from Canaan, Ct. Sold by H. K. Brainard, Thompsonville. Sampled and sent by W. F. Fuller, Suffield.

797. Fertilizer Lime (from Pennsylvania?) Sold by W. F. Fuller, Suffield. Sampled and sent by H. H. Austin.

The direct results of the analyses were as follows:—

	796	797
Lime,	70.12	45.08
Magnesia,	.67	31.59
Oxide of iron and alumina,	.20	3.61
Carbonic acid,	7.76	3.48
Water,	20.50	4.77
Silica,		5.56
Insoluble in acid,	.28	5.78
Undetermined matters and loss,	.47	.13
	100.00	100.00
Cost per ton,	$9.00	$8.00

The compounds actually existing in the Canaan lime, **796**, are almost certainly, both in kind and quantity, as given below. The state of combination of the ingredients of **797** cannot be so positively ascertained from the analysis. The statement below is probably correct except that the silica is combined with the iron and a small part of the lime (perhaps also with a little magnesia and alumina). The quantities of lime, etc., that thus chemically unite to silica in the burning of impure limestones, such as yield **797**, depend upon the temperature to which the rock is subjected in the kiln.

	796	797
Calcium hydrate (slacked lime),	79.61	12.62
Calcium carbonate (carbonate of lime),	17.63	7.91
Magnesium hydrate,	.98	
Magnesium oxide (magnesia),		31.59
Calcium oxide (lime)		32.80
Oxide of iron and alumina,	.20	3.61
Matters insoluble in acid,	.28	5.78
Silica (combined with lime and iron as silicates,)		5.56
Moisture, undetermined matters and loss,	1.30	.13
	100.00	100.00

The effect of much silicates (glass- or slag-like compounds formed by strongly heating together silica and lime or iron) in a lime is to "bind" the lime and retard slacking. The effect of magnesia, especially in large proportion, is also to retard or prevent slacking and to diminish the caustic or corroding quality of the lime.

Sample **797** is stated not to have heated when drenched with water, but after standing three weeks it crumbled without killing the grass on which it was heaped.

The question of the comparative value of the two samples is an important one. **797** was bought for application upon tobacco-land. The value of lime applied to land is of two sorts. It may be of service by its caustic or alkaline character in virtue of which it, for example, provokes decomposition of the inert nitrogen-compounds of the soil and thus acts indirectly as a supply of nitrogen. For this use **796** is much superior to **797**. The other mode of action of fertilizer-lime lies in its direct supply of plant-food. On a soil destitute of magnesia, **797** would be better than **796**, but magnesia is commonly abundant enough in our soils, and while an occasional application of a magnesia fertilizer may be advantageous we may conclude that, generally speaking, a nearly pure lime is preferable to one containing a large proportion of magnesia.

LIMESTONE.

709. Limestone, quarried about forty years ago.
710. Limestone, from top of layer.
Both samples were sent by L. Elliot, Durham.

ANALYSES.

	709	710
Insoluble in acid (sand and soil),	1.84	3.71
Lime,	53.91	52.91
Magnesia,	.63	.52
Phosphoric acid,	.08	.12
Carbonic acid, etc., by difference,	43.54	42.74
	100.00	100.00

The composition may also be stated as follows:—

	709	710
Carbonate of lime,	96.14	94.30
Carbonate of magnesia,	1.32	1.09
Phosphate of lime,	.15	.22
Silica, etc., insoluble in dilute nitric acid,	1.84	3.71
Undetermined matters (carbonate of iron ?) and loss,	.55	.68
	100.00	100.00

These limestones are comparatively pure carbonate of lime.

SHELL MARL.

698. Shell marl sent by Prof. J. Hoyes Panton, Guelph, Canada.

ANALYSIS.

Moisture,	.24
Insoluble in acid,	.41
Oxide of iron,	.29
Lime,	53.03
Magnesia and other matters,	1.07
Carbonic acid and combined water,	44.96
Phosphoric acid,	trace
	100.00

NORFOLK FERTILIZER.

772. Norfolk Fertilizer. Made by Styron, Whitehurst & Co., Norfolk, Va. Sampled, sent, and sold by M. B. W. Wheeler, Westport.

The direct results of analysis were as follows:

Lime,	43.43
Magnesia,	1.39
Soda,	5.44
Potash,	.93
Oxide of iron,	.51
Chlorine,	6.55
Phosphoric acid,	.16
Sulphuric acid,	1.78
Carbonic acid,	11.23
Insoluble matters,	2.67
Moisture at 212°,	16.01
Combined water, by difference,	9.90
	100.00

The actual state of combination of the ingredients of the "Norfolk fertilizer" is probably the following:—

Common salt (sodium chloride),	10.26
Muriate of potash (potassium chloride),	.67
Sulphate of potash (potassium sulphate),	.95
Gypsum (hydrated calcium sulphate)	2.88
Carbonate of lime (calcium carbonate),	25.52
Slacked lime (calcium hydrate),	37.26
Slacked magnesia (magnesium hydrate),	2.02
Phosphate of iron,	.67
Sand and insoluble matters,	2.67
Moisture and loss,	17.10
	100.00

The Norfolk Fertilizer is a mixture of ground oyster-shells and slacked lime with some 15 per cent. of "kainite" or similar low-grade "potash-salts" or the equivalent. Its fertilizing and commercial values are about those of leached ashes. The Connecticut farmer can scarcely afford to pay more than $7 to $8 per ton for it. The price quoted to the Station was $30.

FOSSIL MARL.

786. Fossil Marl. Sampled and sent by Jones Brothers, South Windsor. R. W. Roberts, East Hartford, dealer.

"Fossil Marl" in this instance is the Green Sand Marl of New Jersey. The sample **786** is quite similar to **316** analyzed at this Station in 1879 (see Station Report for that year, p. 46). Below are given the full analysis of **316** and a partial analysis of **786**.

	316	786
Moisture,	16.70	17.64
Combined water,	3.26	
Sand, insoluble silica,	18.33	
Soluble silica,	26.65	
Oxides of iron and alumina,	23.00	
Lime,	.43	
Magnesia,	3.12	
Potash.	5.69	
Soda,	.60	
Phosphoric acid,	.90	.92
Undetermined matters,	.42	
	100.00	
Cost per ton,	.	$10.00

The analysis given in the pamphlet (issued by Hooper & Co., General Agents) accompanying the sample gives phosphoric acid at 2.8 per cent. and potash at 7.3 per cent. The sample contains but one-third that amount of the former, and as to the latter it exists as a silicate—in the mineral *glauconite*, which gives the green color to the marl—and is insoluble or very slowly soluble, and accordingly the marl has little effect as an active fertilizer when used in small doses, but rather belongs to the class of amendments which often produce striking results on poor soils, when applied in large quantities.

This marl has been extremely useful in New Jersey on lands near to market, and but a little way removed from the marl pits, where its cost is but $3 to $5 per ton. To transport it to Connecticut can hardly be profitable to the farmer here, unless all the circumstances are favorable to laying it on at low cost.

Marine Mud.

685. The sample was sent by Wm. T. Foote, Esq., of Guilford.

Analysis.

Water.	45.68
Organic and volatile,	4.54*
Insoluble in acid (sand and soil),	40.97
Oxide of iron and alumina,	6.14
Lime,	.90
Magnesia,	.05
Potash,	.36
Soda,	.56
Sulphuric acid,	.79
Phosphoric acid,	trace
	100.00

* Containing nitrogen 0.18

This Marine Mud, compared with stable manure is as rich or richer in lime, magnesia, potash, soda and sulphuric acid. It contains but one-third as much nitrogen and is quite deficient in phosphoric acid. It would serve admirably to use in connection with fish manures, which supply little besides nitrogen and phosphates.

Mr. Foote writes as follows regarding this mud :—

"The mud is washed into a small bay between Sachem's Head and Mulberry Point; and is flooded at every tide. I have had fifteen years' experience with it on light-textured though dark-colored loam with a clayish subsoil or underlaid by rock. It should be dug in winter; the action of the frost pulverizes it till it is like ashes. It is then left to dry a month or so. If dug in summer it bakes hard. I cart it to fields from twenty rods to half a mile distant. It costs two cents a bushel dumped on the field ready to spread. I use from 800 to 1000 bushels per acre, in drills and in hills, broadcast on pasture or spread and plowed in. When I used 2000 bush. mud to the acre I raised potatoes at the rate of 400 bush. One cart load was accidentally spread upon a space about 15 feet square and plowed in, and a very large crop was the result; from one hill I took 13 potatoes (all there were) which weighed 6½ lbs. With corn I tried alternate rows of mud and yard-manure; the latter from a yard of twenty cows where 1100 bush. of grain had been fed in the winter. Early in the season the mud rows did not show as well as the other; later they caught up and were equal in results to the other, in size of stalk and amount of grain.

In good corn years I have had 100 bush. of shelled corn to the acre with mud alone; but the general average is 75 bush. This last year of late drouth, the best corn was on the driest land with mud. With wheat this year I used barn-yard, hog-pen, and mud manure with an average crop of 25 bush. per acre to all three. With rye I do not find it successful, though others do who have used it on sandier soil. Of English hay I have 3 tons per acre where nothing but mud has been used for years.

Top-dressing pastures once in three years keeps them in fine grass and apparently would do so forever. I do not find it quick enough for an early vegetable garden, without some other more heating manure. With beets I have raised 900 to 1000 bush. per acre."

REVIEW OF THE FERTILIZER MARKET.

Organic Nitrogen in Dried Blood, Azotin and Ammonite was quoted in New York at wholesale in November, 1881, at $23.40 to $24.30 per 100 lbs., which are the maximum figures for the year. It fell a little gradually till January, 1882, and from then on quite rapidly till early summer, when nitrogen in blood sold at $19.90, and in azotin and ammonite at $19.50. Since then prices have advanced but very little, and on Nov. 1, 1882, nitrogen in blood was quoted at $19.73, and in azotin and ammonite at $19.73 to $20.49.

Thirteen analyses of blood, ammonite, fish, cotton seed, castor pomace, etc., made at the New Jersey and Connecticut Stations this year, show that the average retail cost of nitrogen in them has been $21.60 per 100 lbs. The highest price paid was $29.35, the lowest $16.80. In most cases these were *manufacturers'* retail prices, and do not include freight and the charges of middle-men.

Two samples of Castor Pomace from the stock of *retail agents* in this State furnished nitrogen at $23 and $29.35 (allowing 6 cts. and 5 cts. respectively for the phosphoric acid and potash in them), though in the cheaper article there was evidently a large admixture of cotton seed.

The single sample of cotton seed meal analyzed, with the allowance mentioned above for phosphoric acid and potash, furnished nitrogen at $17.35 per 100 lbs.

There is no other ingredient in commercial fertilizers which shows such wide differences in retail cost as organic nitrogen, and none which requires as much judgment in its purchase, if the buyer desires to get it at the best advantage to himself.

Nitrogen in Ammonia Salts, on the first of November, 1881, cost $25.60 per 100 lbs. *at wholesale*, and remained stationary in price till March, 1882. Since then it has fallen, and from June on has been quoted at $22.40 per 100 lbs. The average *retail* price of nitrogen in this form in New York and Philadelphia, as shown by analyses made at the New Jersey Agricultural Experiment Station and published in July, has been $23.35. The single sample examined here from a Connecticut retail dealer furnished nitrogen at $29.11. The difference between this and the retail New York prices is caused in part by cost of handling and transportation.

Nitrogen in Nitrate of Soda has cost *at wholesale* through the year less than in any other form. It was quoted in November, 1881, at $20.40 per 100 lbs., which is the highest figure for the year. From then it steadily declined till last September, when it cost $16.80, and on the first of November of this year stood at $17.55 to $18.40. The average price asked by the large retail houses in New York has been about $22 to $23, according to the bulletin of the New Jersey Station. No analyses have been made in this Station of articles of this class which were of average quality or price.

Soluble Phosphoric Acid in the three samples examined here has cost at retail in this State $10.84 on the average. In New York it has retailed at $10.72 when made from South Carolina rock, and a little less when made from bone black.

Insoluble Phosphoric Acid has shown no very marked changes during the year. Charleston rock unground, "free on board," (f. o. b.) at Charleston was quoted at $8.80 per ton in January, and has fallen since, the quotation on Nov. 1st, 1882, being $6 to $6.50. Ground and rough bone have also been quite steady in price, the latter sort ruling highest in November and December, 1881.

Potash as high grade (80 *per cent.*) *muriate* has been very steady, prices ranging from $3.24 to $4.06 per 100 lbs., since May, 1881, and averaging $3.60; small lots purchased in New York have cost on the average $4. In Connecticut it has retailed this year for about $4.50.

Potash as high grade sulphate seems not to be in the retail market in Connecticut to any amount.

Potash in the double sulphate of potash and magnesia has cost, making liberal valuation for sulphate of magnesia, $6.77 and $6.45 per 100 lbs. at retail in the Connecticut market. Only one sample of kainite has been analyzed here. Potash in that article has retailed in New Jersey for $5.06 per 100 lbs. on the average.

From the Review of the Fertilizer Market it appears that the prices of certain fertilizers have varied very considerably during the year. To take a single instance: the nitrogen of dried blood cost at wholesale not far from 23½ cents a pound in November, 1881, but could be got for a little less than 19 cents a pound 7 months later, in June, 1882. Assuming that the blood had 10 per cent. of nitrogen, this would be a difference of over $7 per ton in the cost, an item well worth saving if it can be saved.

Individual purchasers, buying small lots, cannot probably secure any considerable advantage by watching the state of the market, but farmers' clubs and other associations of farmers may find that it pays them well to carefully watch the market and to buy their fertilizers in one lot and at a time when wholesale prices rule low.

The following explanations will be helpful in the examination of market quotations.

Phosphate rock, *kainite*, *bone*, *fish scrap*, *tankage*, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by an analysis at the time of purchase.

Sulphate of ammonia, *nitrate of soda and muriate of potash* are quoted and sold by the pound and generally their wholesale and retail rates do not differ very widely.

Blood, *azotin and ammonite* are quoted at so much "per unit of ammonia." A "unit of ammonia" is one per cent. or 20 lbs. per ton. To illustrate, if a lot of dried blood has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $3.75 per unit, a ton of it will cost 8½ × 3.75 = $31.88.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given.

Ammonia at	$4.00	per unit is	equivalent to	nitrogen at	24.3	cts.	per lb.
"	3.90	"	"	"	23.7	"	"
"	3.80	"	"	"	23.0	"	"
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.2	"	"

Commercial sulphate of ammonia contains on the average 20 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At 5½	cents per lb.	Nitrogen	costs	27.5	cents per lb.
" 5⅜	"	"	"	26.8	"
" 5¼	"	"	"	26.3	"
" 5⅛	"	"	"	25.6	"
" 5	"	"	"	25.0	"
" 4⅞	"	"	"	24.4	"
" 4¾	"	"	"	23.8	"
" 4⅝	"	"	"	23.1	"
" 4½	"	"	"	22.5	"

Commercial nitrate of soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	3⅝	cents per lb.	Nitrogen costs	23.2	cents per lb.
"	3½	"	" "	22.3	"
"	3⅜	"	" "	21.5	"
"	3¼	"	" "	20.8	"
"	3⅛	"	" "	19.9	"
"	3	"	" "	19.2	"
"	2⅞	"	" "	18.3	"
"	2¾	"	" "	17.6	"
"	2⅝	"	" "	16.9	"
"	2½	"	" "	16.0	"

Commercial muriate of potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

If quoted at	2.25	cts. per lb.	Actual potash costs	4.46	cts. per lb.
"	2.20	"	" "	4.36	"
"	2.15	"	" "	4.26	"
"	2.10	"	" "	4.16	"
"	2.05	"	" "	4.06	"
"	2.00	"	" "	3.96	"
"	1.95	"	" "	3.86	"
"	1.90	"	" "	3.76	"
"	1.85	"	" "	3.66	"
"	1.80	"	" "	3.56	"
"	1.75	"	" "	3.46	"
"	1.70	"	" "	3.36	"
"	1.65	"	" "	3.26	"
"	1.60	"	" "	3.16	"

The accompanying table, prepared by Mr. Hutchinson, shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, during the last 19 months. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20 per cent. and nitrate of soda 15.6 per cent. of nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt. For three months azotin and ammonite were not quoted at all.

	Cost of Nitrogen at Wholesale in				Cost of Potash at Wholesale in
	Blood. cts. per lb.	Azotin and Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1881. May	21.3	21.8	21.9	24.7	3.78
June	21.5	21.8	21.1	24.8	3.86
July	22.0	21.8	20.8	25.6	3.92
August	22.4	22.1	20.8	25.2	4.06
September,	23.8	....	20.9	24.7	3.78
October	23.0	24.3	20.8	24.9	3.64
November	23.3	24.3	20.4	25.6	3.62
December	23.1	....	20.3	25.7	3.60
1882. January	23.0	....	19.9	25.6	3.71
February	22.3	22.2	19.8	25.6	3.60
March	19.6	20.1	18.3	25.0	3.36
April	19.7	19.7	18.4	23.8	3.24
May	19.1	19.7	18.3	22.7	3.26
June	18.9	19.7	16.9	22.4	3.28
July	19.8	19.5	16.8	22.4	3.40
August	19.5	19.5	16.8	22.4	3.52
September	19.7	20.3	17.7	22.4	3.60
October	19.7	20.1	17.8	22.3	3.56
November	19.7	20.1	17.5	22.2	3.56

HOME-MADE SUPERPHOSPHATE.

Occasional inquiries are made at the Station with regard to the method of preparing superphosphate of lime on the farm, and as to the economy of its home manufacture. It is perfectly practicable for a farmer to make a high grade and moderately fine article without any considerable outlay for apparatus. The *economy* of the manufacture depends on the prices which he has to pay for the phosphatic raw material and oil of vitriol delivered on his premises. In general it is probably cheaper for him to buy his superphosphate ready made; but it occasionally happens that he can find in his neighborhood small quantities of suitable material offered at a low rate, being a waste product from some manufacturing establishment, which of itself is comparatively inert as a fertilizer, but which can be economically treated with oil of vitriol on the farm and so be made valuable.

An instance of this kind has come to the notice of the Station within the last year. A gentleman living near a factory where iron was extensively worked found that each year a ton or two of bone char was thrown away which he could get for about $8 per ton. Bone char contains no nitrogen, but a high percentage of phosphate of lime in an inert condition. Applied directly to land little or no immediate effect was to be expected.

It was suggested that he try the experiment of treating this char with oil of vitriol, which he could buy for 1½ cts. per lb. by the carboy. The process employed was as follows: A vat was constructed by laying boards closely together on level ground, and putting up sides eight or ten inches high, after the style of a mortar bed. 500 lbs. of bone char were put in the vat, and spread somewhat, with a slight depression in the middle of the pile where the water and acid were afterwards poured. 15 gallons of water were measured into a barrel and 300 lbs. of the acid were weighed off into a crockery vessel. It could have been weighed into wood but would have charred it somewhat.—The greatest care is necessary in pouring the acid from the carboy. The receiving vessel should be held close to the neck of the carboy to prevent spattering as much as possible, and the eyes kept averted; for the acid destroys the clothing and burns the skin very quickly when it falls on it. A drop on the skin should be immediately wiped off with a cloth and the place well washed.—The water was then poured rather slowly over the bone char and mixed with a hoe till the whole mass was wet. As soon as this was done, the acid was poured off in the same way. The mass became at once very hot, the carbonate of lime, which is always present, was decomposed, and the escape of steam and carbonic acid was attended with much frothing. This must be provided for by making the vat of sufficient size. The materials were worked over and thoroughly mixed with the hoe until the steaming and frothing had about ceased. The mixture then had the consistence of mortar, but within twenty-four hours dried to a crumbly state, and could be pulverized for spreading on the land. In this instance it was mixed with dried blood, which was bought for $35 a ton, and furnished nitrogen at 19 cents a pound. At the end of twenty-four hours samples from different batches of the phosphate were analyzed at the Station. The lowest percentage of soluble phosphoric acid found was 11 per cent., the highest 14.2 per cent., and the average 12.9 per cent. It is believed that the solvent action of the oil of vitriol was not then complete, and that tests made later would have shown a larger percentage of soluble phosphoric acid. The cost of the process was as follows:

2,000 lbs. bone char,	$8.00
1,200 lbs. oil of vitriol,	18.00
Labor,	4.00
	$30.00

Unfortunately no weighing was made of the superphosphate. Of course it could not have been less than 3,200 lbs., the weight of acid and bone, and must have been considerably more, since the sulphate of lime that is formed retains a large quantity of water. But calling its weight 3,200 lbs. and its content of soluble phosphoric acid the lowest found, 11 per cent., we have as a result 352 pounds of soluble phosphoric acid, costing $30, equivalent to $8.52 per 100 lbs., or over $2 per hundred less than the average cost in the retail market during the last year.

PEAT OR SWAMP MUCK.

714. Peat from East Haven Peat Swamp, sent by Henry E. Pardee, New Haven. Surface sample containing roots.

715. Peat from East Haven Peat Swamp, sent by Henry E. Pardee. Sample from beneath **714**, free from roots.

745. Muck sent by Philip T. Vibert, Meriden, Ct.

Analyses.

	714	715	745
The fresh material contains:—			
Water,	70.51	79.66	80.16
Organic and volatile matters,	24.80	17.85	16.95
Ash,	4.69	2.49	2.89
	100.00	100.00	100.00
The organic and volatile matters contain:—			
Nitrogen,	1.08	0.66	0.59
The ash contains:—			
Silica and insoluble,	1.67	.42	.51
Oxide of Iron, Alumina and Phosphoric acid,	.63	.19	.27
Lime,	1.37	.74	1.14
Undetermined,	1.02	1.14	.97
	4.69	2.49	2.89
The dry mucks contain:—			
Organic and volatile matters,	84.09	87.75	85.43
Nitrogen,	3.66	3.24	2.97
Silica and insoluble,	5.66	2.07	2.55
Oxide of Iron, Alumina, &c.,	2.14	.93	1.36
Lime,	4.64	3.64	5.75

The question of bringing a peat or muck swamp into cultivation, is one that frequently arises. The first essential of course, is drainage sufficient to remove the surface water for a depth of several feet. In small swamps the muck is commonly mixed with enough washed-in soil to admit of cultivation directly. Where the area of the bog is considerable this is commonly not the case. Peat so nearly pure as the samples here reported, contains scarcely enough mineral matters to make a good soil if merely drained. Addition of soil, sand or coal ashes would be needful to amend the texture and prevent the peat from cohering together to a crust and shrinking during dry weather in a degree injurious or fatal to crops, unless indeed frequent shallow tillage were resorted to for the prevention of such disaster. As regards plant-food, there is an ample store of the element most costly, to supply artificially, viz.: nitrogen. The fresh material of these samples contains, on the average, as much of this element as stable or yard manure (0.77 per cent.), and this will become available under suitable cultivation. Lime is also abundant. The analysis is not carried out sufficiently to show how the other mineral elements stand, and probably phosphates and potash salts would be shortly needed. With their help these peats would probably make very productive soils for many years to come.

THE COMPOSITION OF TRAP ROCK.

"NEW BRITAIN, CT., June 13, 1882.

"I enclose a sample of the stones and pulverized matter with which our soil abounds. I desire to know if it contains potash or phosphate of lime. I presume you can tell at a glance, but if an analysis is necessary I hope you will make it. This trap rock abounds in all this region. I had an impression that such rotten stone as I send you is rich in all the mineral elements of plant food. JOHN B. SMITH."

It has not been possible hitherto to make an analysis of the sample of decayed trap rock sent by Mr. Smith, and the following answer to his inquiries was based on the general result of such investigations on the subject as have come to the writer's knowledge. By Trap Rock is meant the "blue stone" which forms the material of East and West Rocks at New Haven, of the Hanging Hills of Meriden, and of many similar elevations along the valleys of the Connecticut and Quinnipiac Rivers.

Answer.

The "trap rocks" of this State, so far as they have been analyzed, contain—

7½	to	10½	per cent. of	lime,
5	to	7½	"	magnesia,
2½	to	3½	"	soda,
$\frac{4}{10}$	to	$\frac{7}{10}$	"	potash,
trace	to	$\frac{14}{100}$	"	phos. acid.

The rest of the rock consists of silica, alumina, and oxide of iron. The trap rocks are commonly very slow to disintegrate, some that contain much iron decay more rapidly. During the slow decay, the lime, magnesia and alkalies become soluble in water and wash away, so that the decayed rock is less rich in these substances than the original. The rock is a source of these forms of plant food during its decay, more than afterwards. Still the fine clayey matters that result retain small quantities of plant food, such as you will find stated in the various soil-analyses that have been published in the Station Reports. Phosphoric acid remains mostly in the residue of the decay, and potash is washed out much less relatively than soda and lime. The abundance and vigor of the vegetation on such decayed rock, provided sunlight and moisture are suitably supplied, is a better test of the richness of the material in plant food than analysis can be, for the latter cannot always discriminate between the unaltered rock whose elements are insoluble and inaccessible to the plant, and the available plant food in the soil.

SOILS.

In December, 1881, two samples of soil were sent to the Station for analysis. The analyses were made in due time, and the results are here given with appropriate extracts from the correspondence.

721. Soil received from Thos. E. Porter, Coventry.

722. Soil sent by A. E. S. Bush, Niantic.

ANALYSES.

	721	722
Moisture	2.354	.473
Organic and volatile matters *	10.476	6.577
Potash	.056	.047
Soda,	.074	.093
Lime,	.130	.080
Magnesia,	.130	.186
Oxide of iron and alumina,	3.575	4.542
Sulphuric acid,	.059	.041
Phosphoric acid,	.038	.051
Sand, silica and insoluble silicates,	83.108	87.910
	100.000	100.000
* Containing nitrogen,	.334	.140

Mr. Porter wrote in substance regarding **721**:—

"The soil was taken from different parts of a twenty-five acre meadow. The meadow is surrounded on three sides by hills over which brooks and springs descend and overflow it in part during the wet season. There are no visible springs in the meadow.

"It is ditched on each side by ditches 4 feet wide and 15 to 18 inches deep. The black, wet dirt or soil is 12 inches in depth; then, in places, one or two inches of sand and below this is a thin stratum of bluish clay in some parts and below this again a coarse gravel bed. One family have lived there since 1720 and know that the sod has never until now been broken or plowed. The land is for the most part dry enough for tillage, being upland, so-called. It bears what is called June grass. When the frost comes the June grass stubble curls downward and becomes gray. Cattle will not eat it, and it used to be hard to cut it with scythes. This field is ditched once across which carries the brook mainly by it; it was plowed in the autumn of 1881 for the first time, for the purpose of rotting out the June grass stubble which I want to exterminate and eventually put in Red Top or Fowl Meadow Grass. Wood ashes and barn-yard manure are excellent to bring fertility, but they are scarce. I would like to ascertain what ails this land. It appears to be deficient in plant-food; now what is a restorative? I will also state that this meadow turf peeled up like so many sheepskins, when plowed. I have used bone and muriate of potash, the latter with great success for potatoes."

In reply to Mr. Porter was written as follows:—

"Accompanying this you will find results of the analysis of the sample of soil received from you. All the elements of plant-food are present, and not one of them is deficient in *quantity*. Nitrogen, potash and magnesia are present in as large percentage as in some of the best wheat soils of Illinois. Unfortunately the analysis of a soil gives little information respecting the *state of availability* of the substances found, and experience shows that of the substances present which are indispensable to plant-growth, the one most abundant may be least available! This analysis does not indicate any one ingredient to whose abundance or deficiency the low fertility of the soil is due, and gives, so far as I can see, no clue to a course of treatment for improving it. It leaves us, in fact, in the same state of uncertainty as we were before the analysis was made."

With regard to sample 722 Mr. Bush wrote:—

"I forward to the Station, by express, a sample of our soil. I say 'our' because we, of this neighborhood, have considerable soil of about the same quality apparently, and an analysis of one sample may benefit a good many persons. The sample is taken as fairly as possible from different parts of a plot of about four acres. I have no doubt you will say any fertilizer would be good for it, but, if possible, I would like to know what fruits and vegetables it is best adapted to and what fertilizer is best adapted to make them grow."

To the inquiries of Mr. Bush, answer was made in similar terms as follows:—

"I give herewith the results of the analysis of your soil. I can not find in these figures any satisfactory explanation of its poverty. Everything required by crops is there. Some very productive western soils are no richer in potash. The difficulty with our analyses is that we have no satisfactory means of learning the availability of the substances present. I send you herewith an analysis of a marine mud from Guilford, (No. **685**). (See p. 54). You will observe that it contains no more nitrogen* than your soil, and no weighable amount of phosphoric acid. Its lime, potash, and sulphuric acid are, indeed, 8 to 10 times more abundant than in your soil, but that does not account for the fact that a dressing of 800–1000 bushels of the mud on an acre of Guilford soil renders the latter highly productive. We must infer from the effects of the mud that its elements are in an active, quickly-available form, but the analysis does not reach that point of inquiry, and we are not much wiser in respect to what *special application* may benefit your land or adapt it to fruits, than before the analysis was made."

The application of Mr. Porter for an analysis of his soil was replied to in the following terms: "I regard it as very doubtful if the analysis will be of much service for the desired purpose, having rarely been able to draw very definite conclusions from the analysis of a soil as to what fertilizers were adapted to make it productive."

To this Mr. Porter answered: "I think that if the soil is analyzed we can between us judge what it contains and what it wants—of course there is no certainty—but I have faith that in due time science will discover exactly what any soil is deficient in and what tonic will in any case, promote fertility. The New England farmer, of the present and future, to be successful, must turn to the scientific men for help. The soil is sick and it must be built up the same as animals when sick."

It occasions much regret to be compelled to feel that, for the present, science cannot guarantee to get adequate return for work spent in soil-analysis. Undoubtedly it would be possible to learn more from analyses of the soils here under consideration, than has been learned. No doubt, it would be possible to make much more accurate and refined analyses than those here printed. Doubtless some nearer approach to a knowledge of the availability of the elements might be attained. The Station, probably, has not done as well as might be done in this branch of its work.

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* Two analyses of either would usually differ more as regards nitrogen than the results on 685 and 722.

It has, however, done the best it could, under the circumstances, with due regard to its obligations in other directions.

The following extract from the Report of the Conn. Board of Agriculture for 1881, pp. 87, 88, will perhaps throw some light on this subject:—

"QUESTION. To what expense is a farmer to be if he wishes to send samples of earth to the Experiment Station for chemical analysis?

ANSWER. It will cost nothing but the freight. The answer to that question suggests another.—"What is the use of analyzing a sample of earth?" We had the idea extensively promulgated some twenty or thirty years ago, that if a sample of soil were analyzed by a competent chemist, the competent chemist could tell exactly what to put upon the field to make anything grow. Well, the competent chemist can generally tell what to put upon the field without making an analysis. Plenty of good manure will help in almost any case!

A little calculation will readily show what a chemist *cannot* do. You know that it has been frequently a matter of experience that a hundred pounds of Peruvian guano, of the old-fashioned sort that we had twenty years ago, would make the difference between a good crop and a poor crop, when it happened to be applied to the right land, with the right crop and right weather. That hundred pounds of Peruvian guano contained about fifteen per cent. of nitrogen, about fifteen per cent. of phosphoric acid, and about three per cent. of potash, to which 33 pounds of ingredients its fertilizing value was alone due. The soil of an acre of land, taken to the depth of one foot, will weigh about four millions of pounds. Thirty-three pounds of fertilizer, and four millions of pounds of soil, assuming that the crop got all its nutriment from the first foot of ground, are the two quantities which, put one above the other, the smallest at the top and a line between, make the fraction which the chemist must figure down to if he will find out from an analysis of the soil what element of fertility that soil is deficient in, viz: $\frac{33}{4,000,000}$ or $\frac{1}{121,000}$. But, in fact, if the chemist in two analyses of the same sample of soil gets results which agree within $\frac{1}{10,000}$ he is lucky and his luck does more towards that result than his skill, for usually the tenth of one per cent. or $\frac{1}{1000}$ is about the limit of accuracy in chemical analysis. It may thus easily happen that the chemist cannot by analysis distinguish between two soils, one of which has had a dressing of 1000 lbs. of the best Peruvian guano to the acre, and the other nothing."

Mr. Porter's observation that muriate of potash was used on his land with great success for potatoes, goes to show that potash (soluble in cold hydrochloric acid) while existing in his soil to the extent of 0.056 per cent., or a long ton, (2240 lbs.) per acre, for 1 foot of depth, is not present there in such a state of solubility as that crops can gather it rapidly enough for their necessities.

The fact that a few hundred pounds of active (soluble) fertilizers give good crops, shows that when by external aid plants have been brought to a certain development of root and leaf they are then able to gather a good share of their nourishment from this soil.

The failure of these meadows to give a good crop of good grass may not be altogether due to lack of plant-food. The texture and physical qualities of the soil exercise oftentimes a controlling influence on the kind and amount of vegetation which it supports. Simple drainage and deep tillage which can have no immediate effect on the quantity of the elements that are commonly regarded important to fertilizers or to the soil, often renovate the field by removing too much water and admitting more air, and thus deepening the available tilth.

As Mr. Porter says, "the soil is sick and it must be built up the same as animals when sick." Now the physician when called to a patient will first assure himself that the sanitary conditions are what they should be:—that is, that his patient is warm and dry and his system in a condition to respond to medicine when it is given. If he is not comfortably placed, medicine may do no good and rather aggravate than improve his condition. To carry out the simile, in building up sick land the rule should be, first of all, to make sure that its physical condition is what it should be, and if it is too wet or cold, too compact or too leachy, to remedy these defects by tillage, drainage and the use of amendments. When that is done, we may apply medicine, in the form of fertilizers, if indeed the land does not recuperate without them, but if it is not done little benefit is to be expected from any amount of fertilizers.

This is what Mr. Porter has done with gratifying success. Under date of Nov. 24, 1882, he writes: "We plowed 6 acres in June (1881), harrowed and sowed to buckwheat. The seed did not germinate well, although a neighbor who had some of the same seed got a good crop. This plowed ground on examination developed the reason why the buckwheat did not respond. It was this: the June grass turf is much like a sheepskin with the wool on, turned over, the moisture could not come up through the tough soil. But the following spring it was plowed and stocked down with oats, red top and clover. The oat crop was good, the grass seed made a good catch and last October the red top was six to eight inches high. There are hundreds of acres of this kind of land in the northeastern portion of the United States, and Connecticut especially has her share. According to your analysis, what is now called the poorest soil, almost worthless, is actually a small mine of wealth if nature is aided in throwing off the water; and the plow will frequently do the important part."

ON REDUCING BONES WITH ASHES.

On page 67 of the last report, in discussing this subject it was advised to use gypsum (land plaster) in making a compost heap of bones and ashes. The action of the ashes on the bone is due to the alkaline qualities of their carbonate of potash or of the caustic potash which results from its mixture with quicklime. The use of gypsum was suggested by the fact that this substance is a preservative of animal matter and would tend to prevent waste of nitrogen.

Professor E. W. Hilgard, of San Francisco, Cal., has kindly called my attention to the fact that gypsum (sulphate of lime) destroys the solvent effect of ashes on the bone tissue, as he has found by actual trial, and as must be anticipated from the well-known chemical changes which take place between sulphate of lime and carbonate of potash when they are dissolved together in water. They yield in fact carbonate of lime and sulphate of potash which are quite without effect on the bone.

SALT AND SALTPETRE FOR PRESERVING FOOD.

The following questions were propounded by the Wilton Farmers' Club, through its secretary, D. H. Van Hoosear, Esq.:

"Our Club has had much discussion upon "Butter Salt" and "Saltpeter." I send you to-day samples of both, which please analyze and report upon. Some complain of butter, pork, &c., not keeping; others of brine not being salt enough, yet salt in the barrel.

Could we trouble you to answer the following questions:

1. What is the saving property of salt?

2. What is meant by salt "losing its savor?"

3. Do you find anything detrimental to the keeping of butter, pork, &c., and if so, what, in the samples of salt sent herewith?

4. Is lime in salt injurious to its keeping qualities for butter, pork, &c.?

5. Can salt be *too* fine for salting butter?

6. Which do you think (according to samples) is the best for butter?

7. Is Turk's Island salt as good as rock salt for preserving pork?

(Please give us a standard to go by.)

8. Has saltpeter preserving qualities, and why do we use saltpeter in preserving pork and hams? What effect does it produce on pork and hams?

9. How can we tell an adulterated or impure article of salt or saltpeter?

(One man describes some as "soapsuds," when dissolved in water.)"

Answers.

"1. What is the saving property of salt?"

The putrefaction, or spoiling of meat, and probably also, the rancidity of butter, are caused by microscopic organisms, probably vegetable in their nature, which are latterly known in science as *bacteria*. If the growth and multiplication of these organisms is hindered or prevented, putrefaction and rancidity are correspondingly checked or altogether stopped.

A great variety of substances, such as vinegar, carbolic acid in coal tar, kreosote in wood smoke, camphor, oil of cloves, spirits of turpentine, arsenic, tannin, salicylic acid, sulphurous acid, and other so-called antiseptics arrest decay, and putrefaction by paralyzing or killing the minute living things whose development appears to stand in the closest relation to these changes.

In the preservation of food we can use only such antiseptics as do not interfere with its proper uses and as are at the same time cheaply and generally obtainable. For common uses, "common salt" is most applicable because of all salts it is the cheapest and has the least injurious effect on the health of man, small quantities of it, as an addition to food, being in fact beneficial to health as well as agreeable to the taste.

The antiseptic effect of salt is only fully manifested by a nearly saturated solution of it in water, *i. e.* by a strong brine. When dry salt is sprinkled over meat it shrinks the fiber of the flesh and expels its juice. A strong brine acts in a similar manner and itself becomes thereby diluted. When pork spoils after salting, it is because there is not salt enough where the spoiling occurs, although surplus of salt exists near by.

Brine in which beef has been corned will taint in warm weather unless it is kept saturated by addition of more salt and frequent stirring. Pure salt and also a brine saturated with salt, will gather moisture rapidly from cool damp air, such as often exists in cellars.

The effect of this "hygroscopic" quality of salt is to make a brine grow weaker at the top, and consequently pork which is but just covered by brine, may, on long standing, become tainted, although there is plenty of salt in the barrel. Either more salt should occasionally be sprinkled over the meat or the access of moist air should be prevented by a close cover.

2. Biblical scholars, I believe, explain the passage "Losing its savor," as follows:

The salt used in the New Testament times was obtained by natural evaporation of salt water, and was a good deal mixed with fine earthy matters, clay, etc. When exposed to rain, the salt was dissolved away and the clay remained, having much of the appearance of the original material, but really containing little or no salt, and having therefore lost its savor or taste. Now that we so universally use a very pure salt, the losing or apparent losing of its savor becomes quite impossible.

3. "Do you find anything detrimental to the keeping of butter, pork, etc., and if so, what—in the samples of salt sent herewith?"

Here follow the results of partial analyses of the samples of salt and a statement of their composition, as calculated from the results of analysis. On dissolving the samples in water, only very minute, scarcely weighable, quantities of foreign matters remained undissolved. They are therefore as clean from dirt and mechanical impurity as could be desired.

CHEMICAL ANALYSES OF SAMPLES OF SALT

SENT BY D. H. VAN HOOSEAR.

	1	2	3	4	5
	Deakens Salt. Finney & Benedict, Norwalk.	Ashton Salt. Selleck Bros. Norwalk.	Higgins Salt. H. K. & F. B. Thurber & Co. New York.	Phœnix Fact'y-filled Holmes & Keeler. Norwalk.	Holmes Salt. J. C. Rockwell. Wilton.
Results of partial Analysis.					
Water at 100°	0.69	0.71	0.48	0.77	0.37
Lime	0.67	0.65	0.62	0.66	0.55
Magnesia	0.10	0.09	0.11	0.09	0.07
Sulphuric Acid	0.92	0.82	0.83	0.85	0.84
Composition calculated from the above Analytical Results.					
Water at 100°	0.69	0.71	0.48	0.77	0.37
Sulphate of Lime	1.56	1.40	1.41	1.45	1.33
Chloride of Calcium	0.06	0.14	0.08	0.12	---
Sulphate of Magnesium	---	---	---	---	0.09
Chloride of Magnesium	0.24	0.21	0.26	0.21	0.10
Chloride of Sodium—SALT	97.45	97.54	97.77	97.45	98.11
	100.00	100.00	100.00	100.00	100.00

The composition given is calculated in the manner believed to express most truly the real state of combination of the elements present. *Sulphate of lime* exists in all the samples to the extent of 1.33 to 1.56 per cent. These quantities are practically the same, for the sulphate of lime is tasteless and, in these amounts, without any sensible effect on the quality of the salt.

The three compounds chloride of calcium, chloride of magnesium and sulphate of magnesia, may be classed together, as they are highly soluble bodies with a bitter taste, and so far as I know, are essentially alike in their influence upon the quality of the salt. Of these we observe that the first four samples contain almost identically the same amounts, 30 to 35 ten-thousandths. In the 5th sample they are present in smaller proportion. The latter sample also contains less moisture and from one-third to two-thirds of one per cent. more pure salt than the other samples.

It would be too much to say that these analyses of single small samples establish any even slight superiority of the brand represented by 5 over the others. Several analyses of samples manufactured at different times would need to be made in order to give a fair exhibit of the composition of the various brands. Two analyses of Ashton salt, which I am able to refer to, made by Prof. Cook and Prof. Gœssman, in 1861, give but 11 and 6 ten-thousandths of magnesium chloride and sulphate, without any calcium chloride. The manufacturing process scarcely admits of entire uniformity in the result.

The sulphates and chlorides of calcium and magnesium are all, in themselves considered, objectionable ingredients of salt, because they are foreign matters and not salt. With exception of sulphate of lime they are objectionable on account of their unpleasant taste. The chlorides of magnesium and calcium are further objectionable in table salt, because they greedily attract moisture from the air and make the salt damper than pure salt would become.

A salt containing several per cent. of these bodies would be regarded as quite unfit for dairy use. The presence of a few thousandths of them in salt has, however, no appreciable effect on the taste of salt or on the articles it is used to preserve or to flavor. Just to what point they may be increased in quantity without real detriment to the salt, *i. e.* without noticeably injuring it for its common uses is a nice point to determine. Doubtless each of the samples under consideration is, so far as chemical composition goes, a good salt suited for butter-making, for pork or beef packing or for any domestic purpose, and a tenth of one per cent. of all or any of the sulphates or chlorides of magnesium or calcium added to or taken from them would not be recognizable by any of the results of their use. This opinion is not based on any careful comparative trials of various salts of slightly differing purity, but upon the facts that the kinds of salt generally used rarely contain less and often contain more impurities than these analyses reveal, and that these impurities in these quantities are not recognizable by the taste.

4. "Is lime in salt injurious to its keeping qualities for butter, pork, etc.?"

Lime, as quick lime or slacked lime, I suppose, does not impair the *keeping quality* of the salt, but injures the taste or flavor of the articles salted, and, in case of butter, the appearance. Lime is sometimes employed in salt manufacture, to purify the brine, and some years ago, I believe, salt containing slacked lime, got into market and damaged or was thought to damage a large quantity of butter. The mistake is of so serious a kind to the salt-makers that it will not be likely to occur again.

5. "Can salt be *too fine* for salting butter?"

Yes; salt may be too fine or too coarse, for such use. Fresh churned butter contains a quantity of the milk-serum (butter-milk) which it is one object of salting to remove. When salt is worked into butter each grain of salt gradually dissolves in the butter-milk and withdraws it from the butter, probably shrinking the bulky, jelly-like casein just as salt mixed with a jelly of soap shrinks the soap into a small, firm cake, and unites with the water to make a brine. If the salt be very fine the result is to fill the mass of butter with a multitude of very small drops of brine which are difficult to work out of the butter. On the other hand, if the salt be very coarse the butter-milk will gather in large drops, easy to work out, but the salt grains will not be entirely dissolved and will make the butter too salt and gritty to the taste. The proper fineness, therefore, is that which comes just short of occasioning the last-named difficulty, so that by its use we remove the butter-milk thoroughly, without leaving any unpleasant surplus of salt in the butter.

The Ashton butter-salt, and the Syracuse factory-filled dairy-salt, are commonly reputed to have the degree of fineness suitable for dairy use. According to Alexander Müller, the grains of a good dairy salt should have dimensions lying for the most part between $\frac{1}{25}$ and $\frac{1}{50}$ of an inch in diameter ($\frac{1}{2}$ and 1 millimeter).

6. "Which of the kinds of salt sent do you think (according to the samples) the best for butter?"

The mechanical analysis of these salts is as follows:

	Deakens. 1	Ashton. 2	Higgins. 3	Phœnix. 4	Holmes. 5
Coarser than 2 millimeters,	0.0	0.0	0.0	0.8	0.0
Between 2 and 1.5 "	6.0	4.4	0.0	3.6	0.0
" 1.5 " 1.0 "	11.9	10.9	1.0	10.8	2.2
" 1.0 " 0.5 "	16.9	20.8	13.0	17.5	6.0
Less than 0.5,	65.2	63.9	86.0	67.3	91.8
	100.00	100.00	100.00	100.00	100.00

It will be seen that the Deakens, Ashton and Phœnix salt are quite alike as to mechanical condition. Higgins' and Holmes' salt are very considerably finer.

Alex. Müller (Landwirthsch. Versuchs-Stationen, 1863, Bd. V, S. 187) proposes to test the value of salt by sifting it as above, and values it according to the amount *held on the sieves.* By this test 1, 2 and 4 would be considered better than 3 and 5, the chemical composition of all five kinds being essentially the same; but it is evident that much depends on the way in which the butter and salt are worked together; and while a moderately coarse salt may answer best for the first object of salting, viz: to withdraw the buttermilk, a finer grade may be better suited to the other object, the preservation and seasoning of the butter. What is considered the best dairy salt in Germany is mostly coarser than 0.5 millimeter.

7. "Is Turk's Island salt as good as rock salt for preserving pork?"

The two kinds of salt are essentially the same. The Turk's Island has a good reputation, and though commonly containing some "dirt," its impurities are not of the kind to impair its preserving quality or to injure pork or beef.

8. "Has Saltpeter preserving qualities, and why do we use it in preserving pork and hams?"

Saltpeter has similar preserving qualities to common salt. Being much more expensive, it is not used for preserving simply, but because it gives a red color to lean meat. Saltpeter in much quantity is very injurious to man, and but little should be used in preserving meat intended for human food.

9. "How can we tell an impure or adulterated article of salt or saltpeter?"

Good salt for dairy use should dissolve in water, making a clear or very nearly clear brine. The coarse Turk's Island salt is sometimes very dirty and makes a brine that might be said to look like soap-suds. The same is often true of cheap unrefined saltpeter. Such a brine when strained through a fine cloth or let settle, may be used for preserving meat. It is better, however, to use salt and saltpeter refined from such impurities. The objectionable chlorides of calcium and magnesium if present in much quantity, may be recognized by the bitterness which they give to the salt, but if their amount is small they can only be detected by the chemist's tests.

POISONS.

Case of Suspected Poisoning.

"Hartford, May 24th.

"Dear Sir: I have sent you by express a sample of the intestines of a cow that died under very suspicious circumstances, May 2d, after a week's illness, where all the symptoms pointed to an enteric difficulty. The heifer had been injured on the side just back of the forelegs, while it was being shipped from Massachusetts, and the internal result was apparent on post-mortem examination by way of exudations, adhesions, etc. Yet the reddened, softened, and excoriated condition of the mucous membrane of the stomach and bowels could hardly be accounted for by the injury. I called attention to this point at the examination and inquired if she could have eaten any poisonous substance, paint, etc. Blood in large clots, a pint or more, was found in the first stomach or paunch. There was a peculiar appearance about the food, which was of a greenish aspect.

"There being no clue to poison and a great paucity of active symptoms, I was nearly persuaded to believe that she died from the effects of the injury. But Col. Rathbone, of Lenox, Mass., from whose herd this animal came, has since lost six head, with similar symptoms, and clots of blood in stomach, so reports say: and it is claimed they were all poisoned. This at once strengthened my suspicion and we exhumed the carcass last Thursday and obtained the specimens sent you. The odor is somewhat subdued by carbolic acid. These are the facts, and I should like to have you test the question and report at an early date.

N. Cressy."

The material sent by Dr. Cressy was submitted to a careful examination by Dr. Herbert Smith of the Yale Medical School. Special attention was directed towards poisonous metals such as might exist in paint, to oxalic acid and to vegetable poisons; but no indication of any poisonous substance was obtained.

GALVANIZED IRON AS A SOURCE OF POISON.

Galvanized iron is sheet iron coated with zinc. The latter metal dissolves with great ease in all acids, so that when the juices of fruits or vinegar are put in contact with it the zinc disappears and the juices become impregnated with soluble zinc compounds. Several instances have been reported to the Station where cider has been boiled down in galvanized iron pans with the effect above stated, and the question has arisen whether the cider has thereby become poisonous.

The soluble salts of zinc are certainly not wholesome and are properly ranked among poisons. They are not however an active poison when taken in small doses; and a little zinc dissolved in cider may produce no noticeable ill effects on a vigorous person. Large doses cause disturbance, more or less serious, of the digestive apparatus. Sulphate of zinc, for example, is sometimes used as an emetic. Persons of delicate constitution or in feeble health may be seriously injured by quantities of zinc or other poison which would not perceptibly harm strong and healthy people; and cider or other acid liquids containing zinc should always be looked upon as probably dangerous and their use for domestic purposes should be carefully avoided.

TINNED COPPER, SO-CALLED, A SOURCE OF LEAD POISON.

The Station having occasion to use a vessel of tinned copper for the storage of distilled water ordered one made of a tinsmith in New Haven. The vessel proved totally unfit for its use as the copper was lined not with tin but with an alloy containing so much lead that pure water dissolved it rapidly and carbonate of lead in minute brilliant crystals formed a film on the surface of the water and coated the sides of the vessel.

The tinsmith was unaware of the dangerous nature of the copper, and explained that it was a regular article of manufacture coming from Ansonia in this State. Such metal may be useful for many purposes but is totally unfit for cooking utensils, tea-kettles, etc., and very serious or even fatal consequences may result from its use in the household.

MILK.

By Dr. E. H. Jenkins.

During the last two years the Station has been called upon to make a large number of milk-examinations, partly for retail buyers and sellers, and partly in the interest of the creameries in the State. Between 200 and 300 complete or partial analyses have been made, but only those are referred to here which are believed to be of general interest.*

Before entering into the details of the Station work on the subject of milk, we give a brief outline of the composition of that liquid and of the two methods which serve as tests of its quality.

Chemical Composition of Milk.

An "average" analysis of milk is as follows:—

Water,		87.5
Fat,	3.5	
Casein and albumin,	4.1	
Milk sugar,	4.3	
Ash,	0.6	
Solids,		12.5
		100.0

* *Method of Analysis.*—As the methods of milk analysis used by chemists, differ somewhat, a brief description of the process employed at this Station is given. *Specific gravity* is determined in all cases by the Jolly spring balance. *Water* is determined by drying a weighed quantity of milk, about 1.8 grams, in a weighed capsule containing 10 or 15 grams of washed and ignited sand, till the weight is constant. The contents of the capsule remaining from this determination are transferred to an extractor and the *fat* extracted with absolute ether. The fat is finally dried in a steam bath at 100° C. and weighed. Another weighed portion of milk is dried over the water bath in a capsule of thin glass, capsule and milk residue are pulverized and mixed with soda lime and the nitrogen determined in the usual way. "*Casein*" is reckoned from the amount of nitrogen found, by multiplying by the factor 6.25. This of course includes the albumin and all other nitrogenous matters of the milk. It is only approximately correct, but the results serve for comparing different samples of milk and the method is in general use. The factor 6.4 would no doubt give a closer approximation to the actual amount of nitrogenous matter.

Milk sugar is determined in 8–10 grams of milk, after removing fat and nitrogenous matters by means of copper sulphate and sodium hydrate—(Fresenius' Zeitschrift, 1878, p. 242) by Tollens' method—(Fres. Zeitschrift, 1879, p. 605.) *Ash* is estimated by difference only in those cases where all the other ingredients have been determined.

Water is the most abundant and a necessary, though of itself a worthless ingredient. It constitutes on the average seven-eighths of the total milk, but varies several per cent. from that mean. The valuable ingredients are included in the 12.5 per cent. more or less of matters which remain in the solid state when the water is evaporated off.

All these solids are valuable as food.

Butter is the fat of milk mixed with some 10 or 15 per cent. of water and 1–2 per cent. of the other solids of the milk, together with 2–5 per cent. of salt added in the making.

Butter-milk is the water of milk, with most of the casein and sugar and a small amount of fat.

Cheese is the casein and albumin of milk, with more or less of the fat and other solids and a variable amount of water.

Whey is mostly the water of milk, with the larger share of the sugar and small portions of the other solids.

The worth of milk for common use as food depends on the quantity of solids it contains. It is well established that genuine milk is somewhat variable in composition as respects the proportions of water and solids. It is found that differences of breed, characteristics of the individual animals, period of lactation, quantity and kind of food, climate or weather, state of health and other conditions, which largely affect the quantity or yield of milk, also, though to a much less degree, influence its composition or the proportion of its ingredients.

Milk is also made to depart from the average composition given above, by willful falsification, either by skimming off part of the cream, by adding water directly to the milk or by both operations together. It is difficult to distinguish by simple inspection or ordinary tests, between rich and poor milk, between genuine and moderately adulterated. On the one hand two samples of milk which appear to be different in richness as judged by the color and the rapidity with which the cream rises, may be essentially alike in composition and equally good for cheese-making or for immediate consumption as food. On the other hand, a small amount of watering, and the removal of a part of the cream may escape suspicion and defy detection by the ordinary means.

It is very important therefore to know what are the natural and ordinary limits of the variations in the composition of milk, and how to distinguish such variations from those which result from intentional watering or skimming.

Tests of the quality of milk.—Various methods have been proposed for testing the quality of milk. Of them all, there are but two which are to be depended upon; one of these is the specific gravity (or density) test, the other, chemical analysis.

The specific gravity test is the one commonly employed in the control of market milk, by Boards of Health and police authorities. Milk is, bulk for bulk, slightly heavier than water. A vessel that will contain 1000 grains of water will hold 1029 to 1034 grains of milk. The lactodensimeter, commonly called the lactometer, is a glass spindle with a slender stem marked off into degrees which sinks in milk to different depths according to the specific gravity of the liquid, which can be read from the scale. This instrument, properly constructed and skillfully used, gives the specific gravity, with great accuracy, by a single observation.

Milk is made heavier than water by those of its ingredients, which are heavier than water, namely: casein, albumin, sugar and ash. The fat of milk is lighter than water, and tends to reduce its specific gravity, so that the specific gravity of milk is diminished by adding water and increased by removing fat. Unless, therefore, milk is falsified both by watering and skimming, the specific gravity serves to indicate very exactly its genuineness and its richness.

If milk is watered to any considerable extent, its specific gravity is brought below 1.029 and the lactodensimeter promptly detects the addition. If, however, the milk first be skimmed or the top poured away after some hours' standing, the skimmed or bottom milk will show a high specific gravity and a considerable addition of water may be made without reducing the specific gravity below that of pure milk. Such double falsification of milk requires for its detection that the sample shall be let stand for cream or that chemical analysis shall be resorted to.

The test by chemical analysis is the only absolutely conclusive means of ascertaining the quality of milk. A determination of the solids of milk by evaporating off the water from a known quantity and weighing the residue, will decide whether milk has been watered or the cream removed, and combining both of these frauds only makes the detection of them more certain. If we separate and weigh the fat, the casein and the sugar of a sample of milk, we get an accurate notion of its composition. Ordinarily the determination of the solids and fat suffice for all practical purposes.

The only embarrassment which these tests do not relieve us from, is that occasioned by the natural variations in the composition of milk. The limit of such variation is discussed in the pages that follow.

ANALYSES OF GUERNSEY MILK.

In the table on page 82 are given analyses of the milk of single Guernsey cows of pure breed, owned by Mr. E. Norton of Farmington, Secretary of the American Guernsey Cattle Club. The samples were drawn from the morning's milk. The cows were milked twice daily, morning and evening, between five and six o'clock.

For comparison, the average of these analyses is given below, with the averages of some milk analyses made at the New Jersey Experiment Station in 1880, by the same method which has been employed here. (See the New Jersey Station Report for 1880, p. 59). In the case of each New Jersey herd, 13 analyses were made on as many consecutive days.

		MADE AT THE NEW JERSEY STATION.		
	Guernsey. 6 Cows.	Jersey. 6 Cows.	Ayrshire. 5 Cows.	Native. 6 Cows.
Water,	85.20	85.28	87.15	86.43
Solids,	14.80	14.72	12.85	13.57
Casein,	4.08*	3.67	3.20	3.34
Fat,	5.23	5.21	4.33	4.49
Sugar,	4.50*	4.93	4.60	4.82
Ash,	1.17*	.91	.72	.92
Daily yield per head,		21 lbs. 3 oz.	21 lbs. 4 oz.	22 lbs. 9 oz.

* 10 analyses.

The yield of the Guernsey cows is not known.

The cows of the Ayrshire herd had not been quite so long in milk as the natives. The Jerseys had been longer in milk than either of them.

These figures are here given simply as a contribution to our knowledge of the chemical composition of cows' milk, as affected by the breed. A few results like these, *taken by themselves*, prove very little with regard to this point. In the first instance variations in the chemical composition of milk, like differences in the milk yield, are *individual* peculiarities. By breeding, such differences have, to a greater or less degree, been made permanent and constant; but even within the same breed we still find large

ANALYSES OF MILK OF GUERNSEY COWS. DAIRY OF MR. E. NORTON, FARMINGTON.

Name of cow	GLORIANA.			PRINCESS.			CERES.			FAWN.		LEMON.		AMY.
Date.	Nov. 15.	Dec. 8.	May 16	Nov. 15.	Dec. 8.	May 16	Nov. 15.	Dec. 8.	May 16	Nov. 15.	Dec. 8.	Nov. 15.	Dec. 8.	May 16
Sp. Gr.	1.0326	1.0354	....	1.0334	1.0354	....	1.0340	1.0368	....	1.0340	1.0[illegible]40	1.0353	1.0368	....
Water	85.02	84.98	86.36	86.63	85.90	87.19	82.85	82.94	84.86	84.96	86.05	84.82	85.52	84.66
Solids	14.98	15.02	13.64	13.37	14.10	12.81	17.15	17.06	15.14	15.04	13.95	15.18	14.48	15.34
Casein	4.22	4.13	....	4.16	3.69	....	4.51	4.60	....	4.14	3.77	4.00	3.55	....
Fat	5.00	5.47	4.39	4.00	4.77	4.05	6.62	6.74	6.04	5.23	4.73	5.06	5.06	6.22
Sugar	4.47	4.42	....	4.18	4.39	....	4.57	4.52	....	4.62	4.35	4.69	4.76	....
Ash	1.29	.79	....	1.03	1.25	....	1.45	1.20	....	1.05	1.10	1.43	1.11	....
Date of dropping last calf	March 8, 1882.			April 21, 1882.			March 23, 1882.			Slipped her calf last spring.		April 26, 1882.		Nov., 1881.

variations in yield and quality of milk due to individual differences in cows. For example, the Guernseys have been isolated more completely and bred under more uniform conditions perhaps, than almost any other class of cattle. Yet the milk of Ceres in the table here given, differs as widely from that of the other Guernseys in percentage amount of fat as the average Guernsey milk differs from the Ayrshire in the foregoing comparison.

Analyses of the Mixed Milk of Herds.

During the last year over 200 partial analyses of this kind have been made for creameries in this State. The object has been partly to detect any adulteration but more particularly to furnish some guide for fixing the price to be paid by the creameries to their different patrons for milk. As was to be expected, the managers of creameries everywhere find very great differences in the butter-producing quality of milk from different herds, and both abroad and in this country an effort is being made to scale the prices paid according to the quality of the milk. Two methods are in use for testing the butter yield of milk, namely:—1. churning trials on a small scale, and 2. determinations of the fat by chemical examination. Churning tests require considerable time of the workmen in the creamery, and are not absolutely reliable, because it is not easy to work all samples exactly alike and some of the butters may contain more water and butter-milk than others, which would make the apparent yield larger.

The objections to chemical examination are that it requires a special skill not always at command, and that its results are not perfectly conclusive because the butter yield does not depend alone on the amount of fat in the milk, but also on the size of the fat globules, the quality of the milk serum, and perhaps on still other factors. Creamometer tests and optical tests are quite unreliable, and are not taken into account here.

It was objected by some of the creamery patrons that in their own dairies they got a larger butter yield from their milk than was got in the churning tests at the creamery, and it was this objection partly which led to the carrying out of the milk analyses at the Station. It then appeared that in some cases dairymen got a good deal more butter from their milk than there was of actual fat in it, which clearly indicates that their home-made butter contained considerable water or buttermilk, and probably more than creamery butter.* Perhaps this would be no disadvantage if the butter was used at once, but it would seriously damage its keeping quality.

It is quite evident that quality as well as quantity should be regarded in the sale of milk, and a scale of prices regulated somewhat by the quality will no doubt operate beneficially on all parties. It will then be the aim of all owners of cows to get the richest milk, and not simply the largest yield, without regard to its richness, which latter aim is the chief incentive to adulteration.

Further investigation will be needed before the Station can render the most efficient aid to creameries, milk-producers and milk consumers, but much valuable preliminary work has been already done.

A brief summary of the analyses so far made will be of interest as bearing on the matter of the milk supply of our cities and the tests of the purity and genuineness of milk.

30 analyses of the milk of 12 herds, about 180 head of cows, made in October, 1881, gave:

	Solids.	Fat.
Average,	12.89	4.02
Maximum,	14.28	5.14
Minimum,	12.00	2.68

27 analyses of the milk of the *same herds*, made in July and August, 1882, gave:

	Solids.	Fat.
Average,	12.21	4.23
Maximum,	13.32	5.63
Minimum,	11.02	3.47

77 analyses of the milk of 60 herds made in May, 1882, gave:

	Solids.	Fat.
Average,	12.81	4.05
Maximum,	14.44	5.23
Minimum,	10.93	3.24

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* The variations in the composition of genuine well-worked and unsalted butter are, according to Fleischmann, as follows:—

Water,	from 8 to 18,	average 14 per cent.
Fat,	from 80 to 90,	average 84 per cent.
Other solids,	from 0.8 to 2.4,	average 1.5 per cent.

In the creameries it is usual to set the milk for a fixed time only, say 24 hours, while in domestic practice the milk is skimmed during 36 or 48 hours. In case of Jersey and Guernsey milk and generally milk with large fat-globules whose cream rises quickly, the creamery and home tests should agree; but with milk of those breeds which are characterized by small fat-globules, there might be from this cause a considerable discrepancy.

103 analyses of 55 herds made in July and August, 1882, gave:

	Solids.	Fat.
Average,	12.08	4.03
Maximum,	13.83	5.63
Minimum,	9.79	2.60

The average of 208 analyses of herd milk is:

Solids,	12.40
Fat,	4.02

The results just given show that in the herd-milk examined at this Station, solids varied between 14.4 and 9.8 per cent., and fat between 5.6 and 2.6 per cent. In only one case were the solids below 10 per cent. and in that instance the fat was 3.1 per cent. In 5 cases solids were between 10.0 and 10.5, the fat ranging from 3.1 to 3.5. (Two of these cases represent milk of the same herd.) In 6 cases solids were between 10.5 and 11.0, the fat ranging from 2.8 to 3.9. (One case is the same herd that gave solids below 10 per cent.) In 19 cases the solids fell between 11.0 and 11.5, the fat between 2.6 and 4.5. In 27 cases solids ranged between 11.5 and 12.0, fat between 3.3 and 4.7 per cent. In the other 150 cases the solids were above 12.0 per cent., and the fat ranged from 3.4 per cent. upwards.

	Cases.
Solids below 10 per cent.	1
Solids between 10 and 10.5 per cent.,	5
Solids between 10.5 and 11.0 per cent.,	6
Solids between 11.0 and 11.5 per cent.,	19
Solids between 11.5 and 12.0 per cent.,	27
Solids above 12.0 per cent.,	150
	207

Unfortunately it was not possible to make determinations of specific gravity in the samples here examined. In no case was there any apparent sickness among the cows. The larger number of the cows in these herds were grade Jerseys; but there was also a considerable number of natives, Jersey thoroughbreds and Guernseys.

There is no *absolute certainty* that some of these samples were not either watered or diluted with skimmed milk. It is hard to believe that a milk with only 9.8 per cent. of solids has not been tampered with; on the other hand, it is not reasonable to suspect that the milk of between 50 and 60 herds of cows has been systematically "doctored," to reduce the solids below 12 per cent., the minimum figure below which it has been assumed by some that pure milk never falls,* without this being in any case so clumsily done as to reveal the cheat at once by analysis, or to disclose the knowledge of it to some one in the neighborhood who would bring it to the notice of interested parties.

Considering too, that self-interest as well as common honesty would tend to prevent such fraud in dealings with a company that watched its patrons closely, we cannot do otherwise than accept the majority of these samples as being pure milk.

In a considerable number of these cases we have seen that the per centage of fat and more especially of solids varies widely from the average per centage in milk as given on page 79. Others have found similar variations.

W. Fleischmann (Jahresbericht über Ag. Chem., 1880, 487), found as the annual average in the morning milk of 4 herds of cows, 4 head in each herd, 11.67, 11.89, 11.97 and 11.41 per cent. of solids with 3.2, 3.4, 3.4, 3.2 per cent. of fat respectively. The specific gravities were 1.032, 1.031, 1.0318 and 1.0304. In the evening milk of the same cows he found 11.76, 12.2, 11.97, 11.39 per cent. solids, with 3.0, 3.4, 3.3, 3.0 per cent. fat, and specific gravities 1.0323, 1.0318, 1.0322, 1.0309. In these cases one analysis each of morning and evening milk was made every three weeks; and the cows being under the personal superintendence of the experimenter, the results are perfectly trustworthy.

Dr. Schmœger (Milch-Zeitung, 1881, 787), gives the results of extended observations on the yield and quality of milk from a herd of 45 Dutch cattle in Proskau, from October 15, 1878, to March 31, 1881. The average yield per head from October, 1878, to October, 1879, was 2864 quarts, from October, 1879, to April, 1880, (a half-year) was 1418 quarts, and from April, 1880, to April, 1881, was 2973 quarts. The cows were milked 3 times daily: at 4 and 11 A. M. and 6 P. M. The observations on the *quality* of the milk were as follows:

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* For example, the New Jersey State Law declares that milk which contains less than 12 per cent. of solids shall be considered as adulterated. The British Society of Public Analysts have adopted as the minimum proportions of constituents in unadulterated milk 11.5 per cent. of solid and 2.5 per cent. of fat. By the New Jersey law, 28 per cent. of the samples of herd milk here analyzed during the year would have been condemned, by the British Society's standard nearly 15 per cent.

	Morning Milking.			Noon Milking.			Evening Milking.		
	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
Specific gravity	29.2*	34.0	32.0	29.1	34.0	31.2	29.9	34.5	31.9
Solids			11.31			11.85			11.77
Fat			2.79			3.41			3.26

* Read 1.0292—1.0340, etc.

During one period of six months the average percentage of solids was 11.19 in morning milk, in another period, noon milk had 11.75, and in a third, evening milk had 11.75.

Variations in Milk Solids.—An inspection of all the results above given leads to the conclusion that in pure herd milk the solids may in some cases and at certain seasons sink as low as 10.0 or 10.5 per cent. and the fat to 2.6 per cent.: and that very frequently, (in 28 per cent. of the samples examined at this Station), the solids are less than 12.0 per cent.

In more than 6000 recorded observations on the mixed milk of herds, Bouchardat and Quevenne found that it was always between 1.029 and 1.033. Müller in Bern, from many hundred observations in Switzerland, France, Belgium, England and other places, found the same limits. Fleischmann, in 833 samples of milk sold in Lindau, found only 4 per cent. which had a specific gravity of less than 1.029, and all of these, as he proved, were either from single cows or had been watered. In the reports of examinations made by the police of European cities of herd milk taken in the stables, it is possible to find specific gravities under 1.029, but in these cases there is no certainty or even probability that the determinations were made with sufficient care to avoid sources of error.

It is a matter of great importance to know, not simply what is the average composition of herd-milk, but what composition it may have; what are the limits within which all pure herd-milk comes; and whether it is practicable to establish by law, or by regulation among dealers in milk, a standard of composition which shall distinguish pure milk from that which is watered or skimmed, or at least which shall distinguish between that which is marketable and that which is of too poor a quality to be offered for sale. A consideration of the observations noticed above brings us to the following conclusions with regard to the value of *total solids*, and of *specific gravity*, as criteria for judging of the quality of milk.

We have seen that pure herd-milk shows very wide variations in its content of solids and fat, and variations less striking in its specific gravity. No instance appears to be on record where a competent observer has found for the mixed milk of a number of healthy cows a specific gravity less than 1.029, and we may conclude with certainty, that milk which falls below that density has been watered.

As evidence of watering simply, specific gravity furnishes by far the most satisfactory test, and if 1.029 is adopted as a minimum, no pure milk will be condemned. In some cases moderately watered milk may escape detection.

If we will establish a minimum limit for the percentage of solids and fat which shall in no case condemn pure milk in any locality, we shall have to make it absurdly low, and thus offer a premium on watering milk of good quality.

As between producers and creameries, or wholesale dealers, in any given locality, it is, we believe, perfectly practicable and fair to establish a standard of chemical composition and require that no milk shall be sold which falls below it. In order to establish such a standard, numerous analyses of herd-milk must be made at different times through the year, the samples to be taken from a considerable number of herds; so as to have a clear idea of those variations which are to be expected in that locality, with the changes of the seasons and the feeding. If fairness and accuracy are aimed at, dependence cannot certainly be placed on the results of analyses made in other places, where the popular breeds of cows, the climate, food, and management of cattle are, or may be all different. In such an arrangement it will be seen that "adulteration" will never have to be claimed or proved. The question is simply one of chemical composition and is easily settled.

Of late *skimmed milk* has come to be sold extensively in the cities of this State, being bought at low rates, wholesale, from the creameries by milk dealers, and is too often sold as "whole milk" to the disadvantage of purchasers and the serious embarrassment of milk producers; for it is impossible for an honest milk-man to compete with a dishonest one as long as buyers regard the price of milk as of more account than the quality. This kind of fraud is readily detected by finding the specific gravity and percentage of fat in the milk; but when skimmed milk instead of water has been added to whole milk, it is often impossible to prove the fact by any kind of examination, because the change of composition thus introduced may be less than the natural variations. In the city of New York it is made illegal to offer for sale or even to bring into the city skimmed milk, on the ground that if it once comes into the city it is entirely impossible to exercise such a control as to prevent its sale as whole milk.

Skimmed milk itself is a legitimate article of trade, and a healthful article of food for adults. It is unsuitable for the exclusive food of infants, and its sale with the express or tacit understanding that it is whole milk, is both fraudulent and dangerous to the public health. It has been shown in Berlin and other cities, that infant mortality decreases as the milk control on the part of the authorities becomes more efficient.

In view of the fact that by a law* passed at the last session of the Legislature, the Station may be called upon to decide as to the purity of suspected samples of milk, it was deemed advisable to gather some statistics with regard to the composition of milk found in our market, and in connection with the present discussion these detailed results will be of interest. (See p. 91.) Of these samples 29 were bought of grocers and bakers, 4 direct from milk carts, and 5 represent what was delivered to private families by milk peddlers.

Nos. 5, 8, 15, 19, 24, 29, have undoubtedly been watered, as is indicated by their specific gravity, taken in connection with the high content of water and low content of fat. The lactometer so far as tried, indicated the same thing except in No. 29.

Nos. 6 and 32 are of doubtful purity, though 32 is cleared by the lactometer test. Nos. 18, 31 and 33 have a high specific gravity, while the solids and fat are quite low, which strongly indicates a mixture of skimmed milk with whole milk.† No. 37 has probably been both skimmed (imperfectly) and watered. If it had been skimmed only, the specific gravity would have been much higher; if watered only the fat would have been higher and the specific gravity lower. No. 3 is wholly anomalous on account of its high percentage of fat, accompanied with low percentages of solids and casein and its low specific gravity.

All the samples taken from milk carts and from what was delivered to private families were of fair quality. 13 out of 29 samples obtained from groceries were of poor quality, and in 7 cases the milk had certainly been watered or skimmed or both.

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* See p. 92.

† These *samples* may have been unintentionally skimmed by the removal of the top milk from the can before they were taken.

In every case but one, the price paid was that of whole milk, namely, 4 cents a pint; No. 24 only, was sold for 3 cents.

ANALYSES OF MILK SOLD IN NEW HAVEN.

Station No.	Specific Gravity.	Water.	Solids.	Casein.	Fat.	Degrees New York Board of Health Lactometer.
1	1.030	87.63	12.37	2.61	4.11	---
2	1.032	86.93	13.07	3.62	----	---
3	1.027	88.09	11.91	2.66	4.56	---
4	1.034	87.16	12.84	3.51	3.47	---
5	1.024	92.05	7.95	2.11	2.04	---
6	1.029	88.63	11.37	2.89	3.60	---
7	1.032	87.17	12.83	----	3.95	---
8	----	91.20	8.80	----	2.83	---
9	1.031	87.17	12.83	3.32	4.06	---
10	1.034	87.66	12.34	3.58	3.22	---
11	1.035	86.79	13.21	3.38	3.09	---
12	1.034	86.58	13.42	3.29	4.45	---
13	1.084	87.44	12,56	3.29	3.83	---
14	1.032	87.44	12.56	----	3.97	109
15	1.0256	90.26	9.74	----	2.83	91
16	1.0310	86.97	13.03	----	4.27	113
17	1.0322	86.67	13.33	----	4.54	115
18	1.0337	88.32	11.68	----	2.93	122
19	1.0267	89.79	10.21	----	2.40	94
20	1.0306	87.08	12.92	----	4.29	113
21	1.0322	87.91	12.09	2.88	3.35	---
22	1.0329	86.92	13.08	3.31	4.21	---
23	1.0339	86.94	13.06	----	3.97	---
24	1.0239	89.82	10.18	----	3.52	85
25	1.0340	87.25	12.75	----	3.49	119
26	1.0348	86.80	13.20	----	4.08	120
27	1.0300	88.81	11.19	----	3.62	109
28	1.0313	88.80	11.20	---	3.16	108
29	1.0286	89.83	10.17	----	2.51	102
30	1.0327	88.20	11.80	----	3.06	116
31	1.0356	88.33	11.67	---	2.36	125
32	1.0290	88.42	11.58	----	3.16	110
33	1.0332	88.59	11.41	----	2.37	122
34	1.0301	88.35	11.65	----	3.46	112
35	1.0309	86.19	13.81	----	4.56	119
36	1.0312	87.14	12.86	----	3.99	119
37	1.0297	90.38	9.62	----	1.80	115
38	----	87.08	12.92	----	4.19	---

Control of Market Milk.—The following method of exercising control over the quality of market milk, reported in the Milch Zeitung (1879, p. 205), is worth noticing here. In Brunswick, difficulty was met with in securing convictions for milk adulteration. The wording of the law was such that watering milk could be punished, but skimming could not be; and in many cases where there was very little doubt that milk had been watered, the suspected parties had the benefit of the doubt, and were acquitted. In this dilemma, the authorities had the milk examinations continued as before, and from time to time a record of them was published. The report first stated that in Brunswick 11.1 was regarded as the minimum per cent. of solids in pure milk and 2.2 per cent. as the minimum of fat. Then followed the names and residences of the sellers and the results of analyses of the milk bought of them, giving specific gravity, solids and fat. While in cases of skimming no prosecutions were attempted, the moral effect of the arrangement was salutary, and the result on the quality of the milk supply, satisfactory.

This method, similar to that which, applied to Commercial Fertilizers has worked well in Connecticut, might probably be adopted to advantage in our large towns.

The present State law with regard to the sale of milk is as follows:

AN ACT TO PREVENT THE ADULTERATION OF MILK.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Whoever shall knowingly sell, supply, or bring to be manufactured to any butter or cheese manufactory in this State any milk diluted with water, or adulterated by the addition of any foreign substance, or from which any cream or milk commonly known as strippings has been taken; or whoever shall knowingly bring or supply milk to any butter or cheese manufactory that is tainted or partly sour, shall, for each offense, forfeit and pay a sum not less than twenty-five dollars nor more than one hundred dollars with cost of suit, to be sued for in a court of competent jurisdiction, for the benefit of the person or persons, firm or association, or corporation, or their assigns, upon whom such fraud shall be committed.

SEC. 2. The usual test for quality and the certificate of analysis of the director of the Connecticut Agricultural Experiment Station shall be deemed *prima facie* proof of adulteration.

SEC. 3. No person shall sell, or expose for sale any milk from which the cream or any part thereof has been removed, without distinctly and durably affixing a label, tag, or mark of metal in a conspicuous place upon the outside, and not more than six inches from the top of every can, vessel, or package containing such milk, and such metal label, tag, or mark shall have the words "Skimmed Milk" stamped, printed, or indented thereon in letters not less than one inch in height, and such milk shall only be sold or retailed out of a can, vessel or package so marked.

SEC. 4. No person shall sell or offer for sale, or shall have in possession with intent to sell or offer for sale, any impure or adulterated milk.

SEC. 5. Every person who shall violate the provisions of sections three and four of this act shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined not more than seven dollars, or be imprisoned not more than thirty days or both.

SEC. 6. A printed notice of this law shall be conspicuously posted in all public places, creameries, or factories where milk is received or sold.

Approved, April 25, 1882.

SEED TESTS.

BY DR. E. H. JENKINS.

In the following table are given the results of twenty-four seed tests, some of them made in the interest of dealers and some for private parties.

The percentage of seed which germinates in these laboratory tests does not, and is not claimed to represent exactly the amount which will actually grow to produce healthy plants in farm practice. A seed is counted as good when the rootlet has burst the seed coat and grown to the length of a millimeter, ($\frac{1}{25}$ inch), in an apparently healthy manner. It may not, however, have strength enough left to push its way to the surface of the ground and develop normally. On the farm the success of a planting depends on many things besides the vitality of the seed, viz: on depth of planting, temperature, moisture, etc., and when complaint is made of a poor "catch," the seedsman is slow to acknowledge that the trouble was in the seed rather than in the manner of planting, or the unfavorable weather prevailing at the time. Since in a carefully conducted laboratory test the access of air and light to the seed, the supply of moisture and the temperature can all be very perfectly regulated, the results will in all cases do full justice to the dealer, while they furnish to the purchaser a very fair idea of the quality of the stock. It should be remembered that while seed is too often put on the market which is known by the seller to be old and poor, there may be great differences in the quality of new seed, occasioned by the weather, and other less obvious causes, differences which may not be appreciated by the seed grower himself until the next planting. Cases have come to our notice repeatedly, where fresh seed was sold by one dealer to another which was almost worthless.

Variety.	Station No.	Seed sprouted. Per cent.	Seed remained sound. Per cent.	Seed rotted. Per cent.	One-half sprouted seed germinated in days.
CLOVER:					
Red Clover	158	75.8	7.5	16.7	5
TIMOTHY	159	90.5	5.5	4.0	6
OATS	146	94.5	1.0	4.5	3
	147	95.0	1.0	4.0	3
MAIZE:					
Mammoth Sweet	140	14.0	0.0	86.0	5
Moore's Concord Sweet	141	38.0	0.0	62.0	5
Minnesota Sweet	142	94.0	0.0	6.0	3
Evergreen Sweet	143	43.0	0.0	57.0	3
“ “	145	92.0	0.0	8.0	3
Crosby's Sweet	144	90.5	0.0	9.5	3
CABBAGE:					
Jersey Wakefield	137	12.7	0.0	87.3	4
“ “	157	71.8	4.5	23.7	5
Flat Dutch	150	75.8	0.0	24.2	2
	149	46.3	4.5	49.2	4
SAGE	152	39.8	?	?	9
	153	26.7	?	?	14
ONION:					
Red	138	44.3	34.7	21.0	3
Wethersfield large red	139	82.7	0.0	17.3	1
	151	59.5	12.0	28.5	6
Yellow Danvers	155	47.8	9.5	42.7	5
“ “	156	86.8	1.0	12.2	5
“ “	118	88.5	0.5	11.0	3
“ “	148	44.0	?	?	5
LEEK	154	48.5	18.5	33.0	7

The sample of Oats No. 147, was from a lot purchased in this State, and was sent to the Station for examination, because, so it was asserted, horses refused to eat it. The oats were very musty and were probably unpalatable only on that account. They contained a very small percentage by weight, of seed of foxtail grass, (*Setaria viridis*, and a little *S. glauca*,) and a few seeds of weeds (*Polygonum* and *Chenopodium*.) They weighed 36 lbs. to the bushel and were of average vitality.

The samples of maize seed were all grown in Rochester, N. Y., purported to be of the crop of 1880, and were examined four months after harvest.

Nos. 140, 141 and 143 are of very poor quality and worthless for seed, though the kernels are of average size and weight. The samples named, however, had a yellow dull look instead ot being bright and translucent, which made the purchaser, a seedsman, doubtful of their value.

That year the corn was late, bad weather set in, and it heated in the crib. The proper curing of sweet corn is a rather delicate matter. We understand that some growers now cure it in kilns with perfect success.

Of the samples of Onion Seed, No. 138 purported to be of the last crop, and was tested March 1. The large percentage of seed remaining hard at the end after trial (34.7 per cent.), makes it appear very probable that it was in part or altogether old seed.

Numerous trials made at this Station with onion seed, whose age was certainly known, gave an average of 6 per cent. of hard seed at the end of the trial (in only one case as high as 19 per cent.), when the seed was less than one year old; 23 per cent. when between one and two years old; 52 per cent. when between two and three years old; 68 per cent. when between three and four years old; and 88 per cent. when five years old.*

No. 148 is a sample of the small, light seed, which is winnowed off before the seed is put on the market. It is one-third lighter than that which is marketable and its vitality is small.

No. 118 represents the marketable portion of the same crop as No. 148.

The average amount of seed capable of germination, as found in tests reported in North Carolina, and in this State is, in case of—

Red clover (8 tests),	78.2 per cent.
Timothy (6 tests),	86.3 per cent.
Cabbage (6 tests),	79.5 per cent.
Onion (40 tests),	83.3 per cent.

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* Report of this Station for 1880, p. 98.

The Station's instructions for sampling seeds, are as follows :

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

INSTRUCTIONS FOR SAMPLING SEEDS.

The *Purity and Germinating Power* of Seeds intended for Farm and Garden use are learned by examining a small average sample. A weighed amount of seed is taken, the pure seeds are culled out and weighed, foreign matters and especially noxious seeds are identified, the vitality of the pure seed is tested by careful sprouting trials, and a report is drawn up of the results.

As the test of germinating power requires some time for its completion, a report on samples sent in cannot be ordinarily expected in less than two weeks.

The examination of *grass-mixtures* can only be undertaken in special cases. It requires a large outlay of time and labor which is not often justified by the results.

In selecting a sample for examination the greatest care should be used to have it represent accurately the whole amount from which it was taken. This result will be secured by proceeding as follows :

1. Mix well together with the hand and arm the contents of the package (bag or barrel) or packages of seed.

2. Take out five or six small handfuls or cupfuls* from various parts of the package, mix these together and take a part of this mixture for the sample.

3. Send of the smaller seeds—red top, white clover, timothy, etc., two (2) ounces; of beets, turnips, red clover, etc., four (4) ounces; of wheat and cereals, and of peas and other legumes, eight (8) ounces.

4. Samples may be sent by mail, or otherwise, prepaid, and should be *plainly labeled* and addressed to

CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

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* A small cup may be closed with the palm of the hand, forced down to the desired place, then filled and withdrawn.

Seeds sent in for gratuitous examination must be described on the subjoined form.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

FORM FOR DESCRIPTION OF SAMPLE.

Station No............Received at Station, ...188 .

Each sample of seed sent for gratuitous examination must be accompanied by one of these Forms, with the blanks *below* filled out as fully as practicable.

This Form, filled out and sent with the sample, will serve as a label; but it should be returned *in good order* for filing in the Station Records.

Send with each sample a specimen of any printed circular, or statement that accompanies the seed or is used in its sale.

Name or label of seed,..

....

....

Name and address of Producer or Importer,................................

....

....

Name and address of Dealer from whose stock this sample is taken,

....

....

Date of taking this Sample,..

Selling price per pound or bushel,.......................................

Known or reputed age of seed, ...

Number of packages from which sample is taken,..........................

Signature and P. O. address of person taking and sending the sample.

....

....

The results of the examination are reported to the party sending, on a form of which the following is an example:

REPORT OF SEED TEST.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

New Haven, Conn., 188 .

Examination of

Rec'd 188 Station No.

From

Pure seed, per cent. by weight.

Impurities, per cent. by weight.

Pure seed sprouted during days, per cent. by number.

Pure seed decayed during days, per cent. by number.

Pure seed sound (unsprouted)
after days, per cent. by number.

Of sprouted seed, ½ germinated in days.

1000 seeds weighed grams.

Per cent. value,

The "per cent. value" of a sample of seed is obtained by multiplying its per cent. (by weight) of pure seed into the per cent. (by number) found, or able, to germinate, and dividing by 100. It refers the number of seeds found, or able, to germinate, from "pure seed" back upon the sample itself, in terms of per cent. In case of *perennials only* it takes account of ⅓ of the unsprouted sound seeds, the proportion which, on an average of many observations, has been found to germinate under favorable conditions.

Director.

FEEDING STUFFS.

Twenty samples of Feeding Stuffs have been under examination during 1882, viz:

4 of Maize Fodder.
4 of Maize Ensilage.
8 of Hay.
1 of Rice Feed.
1 of Cotton Seed Meal.
1 of Corn Meal.
1 of Wheat Bran.

MAIZE FODDER AND ENSILAGE.

About September 1, 1881, Dr. M. Miles, recently in charge of the Experimental Department of Houghton Farm, sent to the Station samples of Maize Fodder both from "Field Corn" i. e., Maize planted in hills as usual for the crop of grain, and from "Fodder Corn" or Maize sown more thickly in drills, for the crop of stalks and leaves. These samples were selected with especial care, in duplicate, and dispatched at once to the Station in close boxes. At the same time weighed quantities of the same material were put in a silo where they remained until about the middle of January, 1882, when they were taken out and sent to the Station.

Analyses (more or less complete) of all these samples were made with the prime object of learning something of the kind and degree of chemical change which occurs in the silo. As a control on the results, each of the duplicate samples of the fresh maize stalks were separately examined in order to ascertain what amount of variation in the analyses is attributable to imperfect sampling, it being evidently no easy matter to take from a mass of maize stalks two small portions that exactly correspond in composition to each other or to the mass. The results of the analyses are tabulated on p. 100.

Comparing the analyses of the duplicate samples of Field Corn CXXV and CXXVI we notice that the water content of the fresh material as received at this Station, differs 0.85 per cent. This difference is no doubt partly due to unavoidable errors in the sub-sampling, drying and weighing, in part also no doubt to original and necessary inequality in the samples. The fat and wax (ether extracts) determined on the dry substance are identical. The albuminoids are reckoned from the amounts of nitrogen found in the dry substance by multiplying them by 6¼. Two nitrogen

	FIELD CORN.			FODDER CORN.		
	Fresh (Duplicates).		Ensilaged.	Fresh (Duplicates).		Ensilaged.
Station No.	CXXV.	CXXVI.	CXLIV.	CXXVII.	CXXVIII.	CXLV.
Weight when sent	13 lbs. 0 oz.	13 lbs. 0 oz.	13 lbs. 0 oz.	11 lbs. 2½ oz.		11 lbs. 2½ oz.
Weight when received	12 lbs. 10 oz.	13 lbs. 1½ oz.	12 lbs. 11¼ oz.	10 lbs. 14 oz.	9 lbs. 11 oz.	11 lbs. 6¾ oz
When received	Aug. 29, '81.	Aug. 29, '81.	Jan. 12, '82.	Sept. 1, '81.	Sept. 1, '81.	Jan. 12, '82.
Water	79.72	80.57	82.38	87.15	86.45	87.68
Ash	1.07		1.05	.87		.91
Albuminoids*	1.78	1.87	1.39	1.54	1.16	1.38
Crude Fiber	4.73		4.80	4.19		4.04
N. fr. Extract†	12.46		9.96	6.06		5.62
Ether Extract (fat, etc.)	.24	.23	.42	.19	.19	.37
	100.00		100.00	100.00		100.00
Water Free.						
Ash	5.26		5.98	6.77		7.42
Albuminoids*	8.79	9.64	7.87	11.95	8.56	11.25
Crude Fiber	23.33		27.24	32.62		32.83
N. fr. Extract†	61.43		56.56	47.20		45.50
Ether Extract (fat, etc.)	1.19	1.19	2.35	1.46	1.49	3.00
	100.00		100.00	100.00		100.00

---

* Reckoned as total nitrogen × 6.25.

† Nitrogen-free extract includes carbhydrates (sugar, gum, etc.).

determinations on each sample gave practically the same result. The discrepancy in albuminoids of 0.85 per cent. therefore lies mainly in the sampling.

Turning now to the duplicate Fodder Corn samples we find 0.7 per cent. in the water content. The ether extracts are not essentially discrepant, but the albuminoids differ by 3.39 per cent. This large difference is unquestionably for the most part due to inequality of the original samples as the two nitrogen estimations on each sample agreed perfectly.

Comparing now, on water-free substance, the composition of the ensilage with that of the corn itself, we get no satisfactory evidence of any change in the albuminoids, for the amount found in the field corn ensilage is but 1.34 per cent. less than the average result on the field corn itself, while in case of fodder corn the albuminoids found in the ensilage are 1 per cent. more than the average obtained in the fresh corn. As regards the "Ether Extracts" we observe that in both cases the ensilage contains very nearly double what was got from the fresh corn. In ordinary fodder-analyses the ether extract consists for the most part of oil, fat or wax, and is usually termed fat or crude fat. In the process of ensilage it is not so likely that fat is produced as that lactic acid is formed, perhaps mainly during the sampling and sending (by transformation of sugar), which dissolves freely in ether.

That sugar and perhaps other carbhydrates are to some degree destroyed and lost by fermentation in the silo, is proved by the appearance of fermentation-products, especially carbonic acid gas. Such loss would tend to diminish notably the percentage of nitrogen-free extract and to increase that of the crude fiber. At first glance the analyses of the Field Corn and its ensilage would seem to indicate a considerable loss in this way, for the fiber of the ensilage is nearly 4 per cent. greater than that of the corn, and its carbhydrates, etc. (N. fr. Extract), nearly 5 per cent. less. But the results for Fodder Corn, though pointing in the same direction give much smaller differences (0.2 per cent. less fiber and 1.7 per cent. more N. fr. Extract), differences that bear no proper relation to each other to be accounted for by loss in fermentation, and that are easily attributable to errors of analysis and uneven sampling. Even the larger differences of 4 and 5 per cent. found in case of the Field Corn might be due to differences in the original samples, for if in the albuminoids there could be in two samples a difference of 3.4 per cent., twice that variation should be anticipated on the three times more abundant fiber and carbhydrates.

We conclude then that these analyses demonstrate that this method of working is incompetent to give any clear notions as to the quantity or even as to the kind of changes that go on in the silo. This result was not unexpected, nevertheless, we regarded the questions involved worthy of careful experimental study.

The antiseptic quality of acids, especially of carbonic acid gas, which has lately been demonstrated by Kolbe, is such as to lead to the conclusion that no considerable amount of chemical change or of loss of nutritive matters can go on in the well constructed silo. Dr. Neale has, we believe, found further experimental evidence of that conclusion in recent investigations at the New Jersey Experiment Station.

Broad Rock Farm Ensilage.

A valuable contribution to the literature of Ensilage has been recently made by Mr. Rowland Hazard, of Peace Dale, R. I., President of the Washington County (R. I.) Agricultural Society.

A sample of Mr. Hazard's ensilage was analyzed at the Station, and the results are here given, together with Mr. Hazard's comments, taken from a memorandum printed by him.

The ensilage was made from corn "cut in September, after the ears were well advanced," on the principle that "the first condition of success with a silo, is to have a good crop to put into it."

"Analysis of Ensilage from Broad Rock Farm made at the Connecticut Agricultural Experiment Station. March, 1882. Six months after storage.

			Seventeen other Samples.	
	R. Hazard's Sample.		Minimum in any case of the seventeen.	Maximum in any case of the seventeen.
Water,	77.648	----	74.2	84.9
Ash,	1.779	----	0.8	1.8
Protein,	2.005	----	0.9	1.9
Crude Fibre,	6.018	----	4.7	7.9
Sugar (Glucose),	0.255	12.003	7.0	13.0
Acetic Acid,*	.103			
Alcohol,*	.396			
Other Carbhydrates,	11.249			
Fat (Ether extract),	.547	----	0.3	0.9
	100.000			

* Alcohol was not positively proven to be present to the extent given, but the figures are probably not far from correct. The amounts of both alcohol and acetic acid may easily increase (or change) after the sample leaves the silo, during its transportation or while it awaits the operations of analysis. There is no probability that the ensilage as fed was so sour or so alcoholic as when analyzed. In fact, the odor of ensilage fresh from the silo is, so far as the writer has had opportunity to observe, much less acid than that which has been received at the station for analysis.

"From this analysis the Broad Rock Farm sample is seen to be nearly 40 per cent. better than the best of seventeen* other samples analyzed. It is nearly equal to good grass, and has an apparent nutritive value of about 2½ lbs. of ensilage to 1 of good hay.

"The cost of 2½ tons ensilage = $7.50. A fair estimate for 1 ton of hay = $12."

"COST OF ENSILAGE AT BROAD ROCK FARM. SEPTEMBER, 1881.

Ploughing 9 acres, 9 days, 1 man and pair of oxen at $2.50 per day,	$ 22.50
Seed (part at $4 per bushel, which is useless expense),	9.50
Manure, including ¾ of value and hauling and spreading,	135.00
Planting, 5 days, 2 men and 1 horse at $3.50,	17.50
Cultivating, 4 days, 1 man and 1 horse,	9.00
Cutting, 13 men and 2 teams for 6 days,	120.00
Coal for steam engine,	14.00
	$327.50
Add for repairs on machinery, salt and extras,	32.50
	$360.00

"The quantity of ensilage was 120 tons; cost, excluding the interest on land and on silos, $3 per ton.

"The cost per ton on hay for interest and storage is of course much larger than for ensilage."

"EXPERIMENT IN FEEDING ENSILAGE AT BROAD ROCK FARM. EXPERIMENT BEGAN FEB. 16, 1882, WITH TEN AVERAGE COWS. THE ENSILAGE HAD BEEN STORED FULLY FIVE MONTHS.

"Taste of ensilage decidedly sour, and subsequent analysis as above showed $\frac{103}{1000}$ of 1 per cent. acetic acid. This is equal to about a quart of strong vinegar per 100 pounds. From Feb. 16 fed the ten cows thus, per day: Ensilage at two feeds, 17 lbs. each feed = 34 lbs. per cow. Hay at one feed, 7 lbs. each feed = 7 lbs. per cow. Meal 2 quarts and bran 4 quarts per cow per day. Fed for 7 days, yield of milk was 68 quarts per day. Then changed the feed of the same cows and gave them no ensilage, but instead gave 14 lbs. of hay, making total hay 21 lbs. per day per cow, with meal and bran same as before, and fed for 7 days. Yield of milk was 59 quarts per day. Then changed back to feed same as in the first 7 days, and fed for 7 days. Yield of milk was 66 quarts per day.

---

*In Mr. Hazard's original memorandum eleven other samples were compared.

"From this it appears that 34 lbs. of ensilage is 12 per cent. better than 14 lbs. of hay. The hay, at $12 per ton, cost 8.4; ensilage, at $3 per ton, cost 5.1. Making allowance for the 12 per cent. better result, we have 9.4 cents hay = 5.1 cents ensilage.

"This shows also that 2½ lbs. of ensilage will more than replace 1 lb. of hay; for, reduce 34 lbs. by 12 per cent. = 30 lbs. and 80 lbs. then would equal 14 lbs. hay, or 1 lb. hay = 2¼ ensilage."

Analyses of Hay and Stover.

The subjoined partial analyses made for Prof. Armsby on samples sent by him from the Storrs Agricultural School are here put on record. They confirm the formerly published results of similar analyses. The low content of albuminoids in the timothy and red-top is especially noticeable.

Station No.	Kind of Hay.	When Cut.	Analysis.		
			Water.	Albminoids.	Fiber.
CXXXIII,	Clover,	July 10,	16.07	9.36	29.41
CXXXIV,	Clover Rowen,*	Sept. 1,	16.62	13.00	25.10
CXXXII,	Timothy and Red-top,	Middle of July,	12.96	4.68	28.39
CXL,		Middle of July,	14.30	4.54	31.39
CXXXI,		Last of July,	13.45	6.44	26.49
CXLI,	Mixed Grasses,	Aug. 1,	14.00	7.10	27.80
CXXXIX,	Hungarian and some Red-top,	Last of Aug.,	15.37	6.81	36.00
CXXXV,	Swale,	August,	14.64	5.88	25.44
CXXXVI,	Stover,	Sept. 12,	28.71	3.00	24.53

* From the same field as No. CXXXIII.

CXXXVII. Rice Feed. From stock of Holmes and Keeler, Norwalk. Sampled and sent by D. H. Van Hoosear, Wilton.

Analysis.

		Water-free.
Water,	10.33	----
Ash,	9.62	10.70
Albuminoids,	11.43	12.74
Crude Fiber,	9.93	11.03
N. fr. Extract (carbhydrates),	47.20	52.72
Fat,	11.49	12.81
	100.000	100.00

The composition of this Rice Feed is very near that of average oats or the best maize in respect to albuminoids. It has three times the ash of oats, twice the fat, the same amount of fiber, and fourteen per cent. less carbhydrate. The less carbhydrates are about compensated by the more fat.

OBSERVANCE OF THE FERTILIZER LAW.

MANUFACTURERS *who up to Jan.* 16, 1883, *have complied with Sections* 2 *and* 3 *of the Act concerning Commercial Fertilizers, which went into effect Sept.* 1, *see page* 11, *and have sent samples to the Station and paid Analysis Fees to the Director:*

Firm.	Article.
Glidden & Curtis, Boston, Mass.,	Soluble Pacific Guano.
G. W. Dickenson, Essex, Ct.,	Ivory and Bone Dust.

The two fertilizers above-named are accordingly the only ones selling at $10 or over per ton, whose sale in Connecticut has been legal, from Sept. 1, 1882, to Jan. 16, 1883.

DEALERS *who up to Jan.* 16, 1883, *have complied with Section* 4 *of the Act concerning Commercial Fertilizers, see page* 11, *and reported to the Director of this Station their names, residences and post-office addresses, and the names and brands of fertilizers sold, with the name and address of the manufacturers, importers or parties from whom such fertilizers were obtained:*

Dealers.	Article.	Manufacturer.
J. P. Barstow, Nor'ch,	Americus Bone Meal,	Rafferty & Williams.
J. P. Barstow, Nor'ch,	Crescent (?) Ground Bone,	Lister Bros.
J. P. Barstow, Nor'ch,	Amm. Bone Superphosphate,	E. F. Coe.
J. S. Benton, Guilford,	Pure Ground Bone, extra fine,	Mapes F. & P. G. Co.
J. S. Benton, Guilford,	Mapes Comp. Man. for light soils,	Mapes F. & P. G. Co.
J. S. Benton, Guilford,	Mapes Comp. Man. A. Brand,	Mapes F. & P. G. Co.
J. S. Benton, Guilford,	Mapes Corn Manure,	Mapes F. & P. G. Co.
J. S. Benton, Guilford,	Mapes Potato Manure,	Mapes F. & P. G. Co.
G. S. Clark, Washington Depot, Ct.,	A. Brand Complete Manure,	Mapes F. & P. G. Co.
Geo. W. Denison, Old Saybrook,	Lister Bros. Ground Bone,	Lister Bros.
Geo. W. Denison,	Lister Bros. Phosphate,	Lister Bros.
W. H. Scott & Co., Pequabuck, Litchfield Co., Ct.,	Ground Bone,	Peck Bros.
W. H. Scott & Co., Pequabuck, Litchfield Co., Ct.,	Bradley's Superphosph. of Lime,	Bradley Fertilizing Co.
Wilson & Burr, Midtown,	Stockbridge Manure for Grain,	Bowker Fertilizer Co.
Wilson & Burr,	Pure Ground Bone,	Rogers & Hubbard Co.
Wilson & Burr,	Stockbridge Man. for Potatoes,	Bowker Fertilizer Co.
Wilson & Burr,	Quinn. Fish and Potash, No. 1,	Quinn. Fertilizer Co.
Wilson & Burr,	Quinn. Phosphate.	Quinn. Fertilizer Co.
Wilson & Burr,	Ground Land Plaster,	G. W. Miller, Middlefield
Wilson & Burr,	Stockbridge Manures,	Bowker Fertilizer Co.

LEGISLATIVE ACTS RELATING TO THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

AN ACT ESTABLISHING THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. That for the purpose of promoting agriculture by scientific investigation and experiments, an institution is hereby established; to be called and known as The Connecticut Agricultural Experiment Station.

SEC. 2. The management of this institution shall be committed to a Board of Control, to consist of eight members, one member to be selected by the State Board of Agriculture, one member by the State Agricultural Society, one member by the Governing Board of the Sheffield Scientific School at New Haven, and one member by the Board of Trustees of the Wesleyan University at Middletown, and two members to be appointed by the Governor of this State, with the advice and consent of the Senate. The Governor of the State, and the person appointed as hereinafter provided to be the Director of the Station, shall also be *ex officio* members of the Board of Control.

SEC. 3. After the appointment of the members of the Board of Control as aforesaid, said members shall meet and organize by the choice from among their number of a President, a Secretary, and a Treasurer, who shall be elected annually, and shall hold their respective offices one year, and until the choice of their successors. Five members of said Board shall constitute a quorum thereof for the transaction of business.

SEC. 4. Said Board shall meet annually after the first meeting thereof, on the third Tuesday in January in each year, at such place in the city of Hartford as may be designated by the President of said Board, and at such other times and places, upon the call of the President, as may be deemed necessary, and may fill vacancies which may occur in the officers of said Board.

SEC. 5. Said Board of Control shall locate and have the general management of the institution hereby established, and shall appoint a Director, who shall have the general management and oversight of the experiments and investigations which shall be necessary to accomplish the objects of said institution, and shall employ competent and suitable chemists and other persons necessary to the carrying on of the work of the Station. It shall have power to own such real and personal estate as may be necessary for carrying on its work, and to receive title to the same by deed, devise, or bequest. It shall expend all moneys appropriated by the State in the prosecution of the work for which said institution is established, and shall use for the same purpose the income from all funds and endowments which it may hereafter receive from other sources, and may sue and be sued, plead and be impleaded, in all courts, by the name of The Connecticut Agricultural Experiment Station. It shall make an annual report to the Legislature which shall not exceed two hundred printed pages, of which not exceeding three thousand copies shall be printed.

SEC. 6. The sum of five thousand dollars annually is hereby appropriated to said Connecticut Agricultural Experiment Station, which shall be paid in equal quarterly installments to the Treasurer of said Board of Control, upon the order of the Comptroller, who is hereby directed to draw his order for the same; and the Treasurer of said Board of Control shall be required, before entering upon the duties of his office, to give bond with surety to the Treasurer of the State of Connecticut in the sum of ten thousand dollars, for the faithful discharge of his duties as such Treasurer.

SEC. 7. Upon the death or resignation of any of the members of the Board of Control, the authority or institution by which such deceased member was originally appointed shall fill the vacancy so occasioned.

SEC. 8. Professor Samuel W. Johnson, of New Haven, is hereby empowered to appoint and call the first meeting of said Board of Control as soon as may be practicable after the appointment of the members thereof, and he shall notify all said members of the time and place of said meeting. Two of said members shall hold office for one year, two of them for two years, and two of them for three years; and at said first meeting they shall determine by lot which of said members shall hold office for one year, which for two years, and which for three years. All members of said Board thereafter chosen or appointed, except such as are appointed or chosen to fill vacancies in said Board, shall continue in office for the term of three years from the first day of July next succeeding such appointment.

SEC. 9. This act shall take effect from its passage.

Approved March 21, 1877.

AN ACT RELATING TO THE PRINTING OF THE REPORT OF THE STATE BOARD OF AGRICULTURE AND OF THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SEC. 1. The Comptroller shall annually cause to be printed, at the expense of the State, five thousand copies each of the report of the State Board of Agriculture and of the Connecticut Agricultural Experiment Station.

SEC. 2. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, March 19, 1879.

AN ACT CONCERNING THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. The sum of twenty-five thousand dollars is hereby appropriated to the Connecticut Agricultural Experiment Station for the purpose of buying a suitable lot and erecting thereon buildings, and equipping the same for the permanent use of said Station, but the title to such lot and to all buildings, and other improvements placed thereon shall be vested in the State of Connecticut.

SEC. 2. The Board of Control of said Connecticut Agricultural Experiment Station, or a duly authorized committee consisting of members of said Board of Control, shall have and exercise exclusive management, control, and expenditure of the sum appropriated by this act for the purposes aforesaid, shall select and determine the site, and the purchase thereof, the plans of said buildings, and the cost, construction, and equipment thereof, and shall pay for the same out of said sum; *provided always*, that the sum or sums so expended shall not exceed in the aggregate the sum hereby appropriated.

SEC. 3. The Comptroller is hereby authorized and directed to draw his order on the Treasurer of the State in favor of said Board of Control, in such amounts as from time to time said Board of

Control, or its duly authorized committee may require for the purposes aforesaid, not exceeding in the aggregate said sum of twenty-five thousand dollars, and a full and particular account shall be kept by said Board of Control of all moneys expended under this act, which account shall be audited by the Comptroller.

Approved, April 26, 1882.

AN ACT CONCERNING THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section six of chapter one hundred and fifty-eight of the Public Acts of 1877, being an act entitled An Act establishing the Connecticut Agricultural Experiment Station, is hereby amended so as to make the sum annually appropriated to said Station eight thousand dollars.

Approved, April 25, 1882.

AN ACT CONCERNING FERTILIZERS.

(See pages 11–13.)

AN ACT TO PREVENT THE ADULTERATION OF MILK.

(See page 94.)

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ANNUAL REPORT

OF

The Connecticut Agricultural

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For 1883.

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OFFICERS

OF

The Connecticut Agricultural Experiment Station,

1883.

STATE BOARD OF CONTROL.

Ex-officio.
HIS EXC. THOMAS M. WALLER, *President.*

Appointed by Connecticut State Agricultural Society: — **Term expires**
HON. E. H. HYDE, Stafford, *Vice-President.* — **July 1, 1885.**

Appointed by Board of Trustees of Wesleyan University:
PROF. W. O. ATWATER, Middletown. — **1885.**

Appointed by Board of Agriculture:
T. S. GOLD, West Cornwall. — **1886.**

Appointed by Governor and Senate:
EDWIN HOYT, New Canaan. — **1886.**
JAMES J. WEBB, Hamden. — **1884.**

Appointed by Governing Board of Sheffield Scientific School:
W. H. BREWER, New Haven, *Secretary and Treasurer.* — **1884.**

Ex-officio.
S. W. JOHNSON, New Haven, *Director.*

Executive Committee. (James J. Webb, W. H. Brewer, S. W. Johnson)

Chemists.

E. H. JENKINS, PH.D., *Vice Director.*
E. H. BOGARDUS.
C. A. HUTCHINSON, B.S.
E. H. FARRINGTON, B.S.
MILTON WHITNEY.

In charge of Buildings and Grounds.
CHARLES J. RICE.

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, waters, milks, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on the various subjects of Agricultural Science, for the use and advantage of the Citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, &c., &c., for the Citizens of Connecticut *without charge*, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 17.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmer is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be prepaid, and all communications should be directed, not to individual officers, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN CONN.

☞ Station Grounds, Laboratory and Office are on Suburban St., between Whitney Avenue and Prospect St., 1¼ miles North of City Hall. Suburban St. may be reached by Whitney Lake Horse Cars, which leave corner of Chapel and Church Sts. each hour and half hour.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State St., or from Peck & Bishop's Office in Union R. R. Depot.

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REPORT OF THE BOARD OF CONTROL.

To the General Assembly of the State of Connecticut:

GENTLEMEN:—The Board of Control of THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION herewith submits to your Honorable Body the Annual Reports of the Director and of the Treasurer, made to the Board at its Annual Meeting, held in Hartford, January 15th, 1884.

During the year the work of the Station has been carried on at its new quarters, which were already occupied and nearly ready for chemical work on the date of the previous annual meeting of the Board. The chemical laboratory was ready a few weeks later and has been in continuous use since. This use has confirmed the expectations of the Board as to its special adaptation to the work for which it was planned. The repairs and improvements on the place went on, however, until midsummer.

The Building Committee have still eleven hundred sixty-one (1161) dollars of the special appropriation on hand. They report that the visible needs of the Station exceed this small sum, and they have therefore delayed expending it until the coming year, by which time the experience of the Station will decide which of the several needs are the most imperative, and how the balance can be most advantageously used.

The people of the State use the Station more and more each year and the problem becomes more difficult, how to best do the varied work asked for: and to facilitate the administration of the Station affairs in the new and enlarged quarters, the Board of Control has appointed Dr. Jenkins Vice Director.

THOMAS M. WALLER,
President.

WM. H. BREWER,
Secretary.

REPORT OF THE TREASURER.

Wm. H. Brewer, ***in account with The Connecticut Agricultural Experiment Station, Jan. 17th to Nov. 30th, 1883.***

RECEIPTS.

Balance from account of 1882	$1,673.68	
State Treasurer (from Annual Appropriation)	6,000.00	
Licenses for sale of Fertilizers and Fees for Analyses	2,443.30	
Other receipts	8.55	
		$10,125.53

PAYMENTS.

Salaries	$5,244.98	
Laboratory Expenses	2,565.01	
Furniture and repairs on house	299.67	
The Grounds and Establishment	454.72	
Fuel	311.50	
Water	132.00	
Gas	150.30	
Insurance	39.50	
Collecting Fertilizers	70.61	
Traveling Expenses of Board of Control	19.11	
Printing	202.10	
Stationery	62.42	
Postage	108.55	
Telephone	107.55	
Library	70.15	
Miscellaneous Sundries	283.92	
Cash balance on hand	3.44	
		$10,125.53

WM. H. BREWER, *Treasurer.*

MEMORANDUM.

There is due the Station two hundred thirteen (213) dollars for analyses made in the laboratory; and an inventory of laboratory apparatus, office furniture, chamber furniture, books and publications on hand, Nov. 30th, 1883, is valued at two thousand four hundred and ninety-six (2,496) dollars.

The previous reports of the treasurer have covered fiscal years ending with the date of the annual meeting of the Board of Control, on the third Tuesday of January of each year. The above account is for the period embraced between the previous annual meeting of the Board of Control and the close of the fiscal year of the State of Connecticut. Hereafter the fiscal year of the Station will conform to that of the State.

Of the special appropriation "for the purpose of buying a lot and erecting thereon buildings, and equipping the same for the permanent use of the Station," there has been expended during the period above indicated, three thousand twenty-nine dollars and ninety-six cents ($3,029.96), leaving a balance of eleven hundred sixty-one (1,161) dollars in my hands for the completion of the work projected.

WM. H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

During the winter of 1882–83 the Station was without laboratory facilities. On the first of March, 1883, the new laboratory was so nearly completed that chemical work could be begun, and in the following pages is given an account of this work from March 1st to December 1st, so far as it is of interest to the public. Much time and pains have necessarily been given to testing analytical methods and controlling results, in order to insure the utmost accuracy, but, in most cases, this work having no general interest, is not suited to publication.

The fertilizer law requires the Director of this Station to "cause one or more analyses of each fertilizer to be made and published annually." This has considerably increased the work on fertilizers, and during the last nine months 219 analyses have been made, nearly one-half of them on samples of complex composition, each one requiring six determinations in duplicate. In connection with the fertilizer work, various investigations have been made, with a view to securing greater accuracy in work and rapidity in its execution. Some valuable results have been obtained, which are noticed on subsequent pages.

Fifteen partial or complete analyses of milk have been made for creameries and individual dairymen.

A modification of Liebermann's method for determining the fat in milk has been devised, which makes it possible to execute a large number of fat determinations in a short time, and which, it is believed, will be of service in work for the creameries of the State or in dairy experiments.

Three samples of butter, suspected of adulteration, have been tested with negative results.

Of fodders, twenty analyses have been made.

In connection with them a table has been prepared, giving the average composition (with the maximum and minimum figures) of American fodders and feeding stuffs, compiled from all analyses which could be secured up to September 1st, 1883. The separate analyses are collected and preserved at the Station, with references to the journals in which they were first published.

One toxical examination has been made, which showed the presence of arsenic and copper (Paris green) in the bowel of a horse which had died suddenly.

One hundred and twenty-one seed examinations have been made, chiefly on onion seed, and some experiments on the best temperature for the germination of onion seed are reported in their proper place.

The Bulletins of the Station have been only four in number, but they have aggregated thirty-four carefully printed pages of the style of this Report, and were stitched for convenience of preservation. As required by law, two copies at least (usually a larger number) have been sent to each post-office in the State in special envelopes, on which was printed the following:

"The Director of the Connecticut Agricultural Station shall, from time to time, as Bulletins of said Station may be issued, mail, or cause to be mailed two copies at least of such Bulletins to each post-office in the State."

Section 10 *of "An Act Concerning Commercial Fertilizers," passed by the General Assembly, to take effect Sept.* 1, 1882.

☞ The postmaster will greatly serve the public by distributing the enclosed bulletins to farmers. ☜

The Bulletins have also been sent as usual to all of the Agricultural Societies and Farmers' Clubs, and to all the newspapers in the State. They have been reprinted in the *Connecticut Farmer* and in agricultural papers in other States.

FERTILIZERS.

THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a new Fertilizer Law, which went into effect September 1, 1882, and which repeals and takes the place of all previous legislation on this subject in this State.

Since a full understanding of the provisions and penalties of this law is important to all parties who buy or sell commercial fertilizers, attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law of 1882 holds the *seller* responsible for affixing a correct label or statement to every package or lot sold or offered, as well as for the payment of an analysis fee of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, unless the manufacturer or importer shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a certified statement of composition, net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a sealed sample shall be deposited with him. Section 2.

3. It is also provided that every person in the State who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

Here follows the full text of the law, with explanatory footnotes by the Director:

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

GENERAL ASSEMBLY,
January Session, A. D. 1882.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

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* A statement of the per cents. of Nitrogen, Phosphoric Acid (P_2O_5) and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric Acid.

For Potash Salts give always the per cent. of Potash (potassium oxide); that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

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* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer. On receipt of statements, samples and analysis-fees, the Station will issue Certificates of compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

SEC. 6. Every manufacturer of fish guano, or fertilizer of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided*, however, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

SEC. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

SEC. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

SEC. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the station, and shall cause one or more analyses of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

SEC. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed.

SEC. 12. This act shall take effect on the first day of September, 1882.

OBSERVANCE OF THE FERTILIZER LAW.

Here follows a list of those manufacturers who up to Dec. 1, 1883, have essentially complied with Sections 2 and 3 of the above Act concerning Commercial Fertilizers, the names of the goods whose sale has thus been made legal, and the time of compliance.

Firm.	Articles.	Date.
Atlantic & Va. Fertilizing Co.	The Long Islander Ammoniated Superphosphate of Lime with Potash.	May 24.
	The Orient Complete Manure.	"
H. J. Baker & Bro., 215 Pearl St., New York.	Castor Pomace.	Apr. 26.
	Pelican Bone Fertilizer.	"
	A. A. Ammoniated Superphosphate.	"
	Complete Manure for Corn.	"
	" " Potatoes.	"
	" " Tobacco.	"
	Kainit.	May 16.
J. P. Barstow & Co., Norwich, Conn.	Rafferty and Williams Americus Bone Meal.	July 2.
P. W. Bennett, Rock Fall, Conn.	Ground Rone.	Oct. 5.
Bosworth Bros., Putnam, Conn.	Superphosphate of Lime.	May 8.
	Bone Meal.	"
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Grain Manure.	Apr. 12.
	" Vegetable Manure.	"
	" Forage Crop "	"
	Bowker's Hill and Drill Phosphate.	"
	" Brighton "	"
	" Fish and Potash.	"
	" Fine Ground Dry Fish.	"
	" Fresh Milled Kainit.	"
Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Bradley's Superphosphate.	March 21.
	B. D. Sea Fowl Guano.	"
	Original Coe's Superphosphate.	"
	English Lawn Fertilizer.	June 27.
Robert B. Brown Oil Co., St. Louis.	I. X. L. Castor Pomace.	May 31.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.	March 6.
	Great Planet "A."	May 25.
E. Frank Coe, 16 Burling Slip, New York.	Ammoniated Bone Superphosphate.	Apr. 25.
	Dissolved Bones.	"
Russell Coe, Linden, N. J.	Russell Coe's Ammoniated Bone Superphosphate.	March 8.
Collier White Lead and Oil Co., St. Louis. By F. Ellsworth, Hartford.	Collier White Lead and Oil Co., Castor Pomace.	May 22.
Buffalo Fertilizer and Chemical Works, L. L. Crocker, Buffalo, N. Y.	Ammoniated Bone Superphosphate.	March 20.
	Potato, Hop and Tobacco Phosphate.	"
L. B. Darling & Co., Pawtucket, R. I.	Ground Bone.	March 22.
	Animal Fertilizer.	"
G. W. Dickinson, Essex, Conn.	Ivory and Bone Dust.	Sept. 20.
Dole's Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	Common Sense Fertilizer, No. 2.	May 5.
	" " No. 3.	"

Firm.	Articles.	Date.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.	Oct. 6, '82.
Geo. L. Harris & Son, Eagleville, Conn.	Pure Bone Phosphate.	Apr. 20.
	Pure Ground Bone.	“
Lister Brothers, Newark, N. J.	Ground Bone.	May 9.
	Potato Fertilizer.	“
	Ammoniated Dissolved Bone.	“
Manhattan Chemical Co., 276 Pearl St., N. Y.	Cooke's Blood Guano.	May 23.
The Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	The Mapes' Potato Manure.	May 2.
	“ Corn “	“
	“ Complete Manure for light soils.	“
	“ Tobacco Manure, Connecticut Brand.	“
	“ Tobacco Manure for use with stems.	“
	“ Grass and Grain Spring Top Dressing.	“
	“ Complete Manure, “A” Brand.	“
	Plain Superphosphate, High Grade.	“
The Geo. W. Miles Co., Milford, Conn.	I. X. L. Ammoniated Bone Superphosphate.	Apr. 9.
	“C” Island Dry Fish Guano.	“
	Fish and Potash.	“
Geo. W. Miller, Middlefield, Ct.	Raw Bone Phosphate.	June 18.
	Ground Bone	“
A. Mitchell, Linden, N. J.	Standard Superphosphate.	June 22.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizer for Roots, Potatoes and Vegetables.	May 26.
	Chittenden's Complete Manure for Grain.	“
	Chittenden's Ammoniated Bone Superphosphate.	“
	Chittenden's Fish and Potash.	“
New Haven Fertilizer Co., New Haven, Conn.	Ammoniated Superphosphate.	May 9.
Peck Brothers, Northfield, Ct.	Ground Bone.	May 31.
Preston Fertilizer Co., Greenpoint Station, Brooklyn, N. Y.	Ammoniated Bone Superphosphate.	March 26.
	Dried and Ground Fish Guano.	“
	Ground Bone.	“
Quinnipiac Fertilizer Co., New London, Conn.	Quinnipiac Phosphate.	Apr. 30.
	Dry Ground Fish.	“
	Fish and Potash, crossed Fishes Brand.	“
	Fish and Potash, plain Brand.	“
Quinnipiac Co., Wallingford, Ct.	Meat and Plaster.	May 7.
	Quinnipiac Co's Bone.	“
Read & Co., 34 Beaver St., N. Y.	Farmers' Friend Fertilizer.	May 14.
	Matchless Tobacco Manure.	“
The Rogers & Hubbard Co., Middletown, Conn.	Pure Raw Knuckle Bone Meal.	June 1.
	Pure Raw Knuckle Bone, Fine, “A.”	“
M. L. Shoemaker, Philadelphia. By F. Ellsworth, Hartford.	Swift-sure Bone Meal.	May 26.
St. Louis Lead and Oil Co. By F. Ellsworth, Hartford.	St. Louis Lead & Oil Co., Castor Pomace.	May 22.
F. C. Slade, Oakville, Conn.	Ground Bone.	June 1.
Edmund Smith, So. Canterbury, Conn.	Ground Bone.	June 11.

Firm.	Articles.	Date.
Paul Thompson, 238 State St., Hartford, Conn.	Mineral Manure for Tobacco and other Crops.	May 18.
Williams, Clark & Co., 109 Pearl St., New York.	Fish and Potash.	March 22.
	Universal Ammoniated Dissolved Bone.	"
	Americus Ammoniated Bone Superphosphate.	"
	Muriate of Potash.	May 21.
	Kainit.	May 15.

FERTILIZERS.*

ANALYSES.

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that can work against the public good.

During 1883, two hundred and nineteen (219) samples of fertilizers have been analyzed. Of these, 17 were examined for private parties, and the remainder, 102, for the general use of the citizens of the State.

The samples analyzed for the public benefit have in a few cases only been sent in by purchasers and consumers. Most of them have been supplied by agents of the Station who during the spring and early summer endeavored to visit all sections of the State, to take one or more samples of every brand of fertilizer offered for sale in the State, and to take them from the stock of dealers in remote places as well as from centers of trade.

* The matter of this and of several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied with a few appropriate alterations from the Report for 1881. This repetition appears to be necessary for the use of readers who have not seen former Reports.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one. The contents of bags or barrels are rapidly and accurately sampled by means of a brass sampler made by McFadden and Dooley, New Brunswick, N. J., on a pattern suggested by Dr. A. T. Neale of the New Jersey Experiment Station. In the past the Station has been in several instances seriously embarrassed on account of the carelessness of those who have drawn and sent in samples for analysis. This trouble is avoided by the present system which could not earlier be adopted for lack of means.

The Station none the less desires the coöperation of farmers and farmers' clubs in calling its attention to the appearance of new brands of fertilizers in the State and in securing samples of all goods offered for sale. All such samples are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION.

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

The *Commercial Value* of a high-priced Fertilizer can be estimated, if the amounts *per cent.* of its principal fertilizing elements are known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit-can or tin box, holding about *one quart*, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

THE CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

The foregoing instructions may be over-nice in some cases, but they are not intended to take the place of good sense on the part of those who are interested in learning the true composition of a fertilizer. Any method of operating that will yield a *fair sample* is good enough.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin tube, like a dipper handle, put well down into the packages, in a good number of places will give a fair sample with great ease. With dry, coarse articles, such as ground bone, there is likely to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling. Otherwise the analysis will certainly misrepresent the article whose value it is intended to fix.

The quantity sent should not be too small. When the material is fine and uniform, and has been carefully sampled, a pint may be enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the same should not be *less than one quart.*

It is also important that samples for analysis should be taken at the time when the fertilizer is purchased, and immediately dispatched to the station. Moist fish, blood or cotton seed will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

These changes in the composition of a sample not suitably preserved must invalidate any conclusions from its analysis, and work serious injustice either to the manufacturer or to the consumer.

It doubtless often happens that a purchaser on laying in a stock of fertilizers decides that he will not then trouble the Station to analyze the goods he has obtained, but will set aside samples which he can send for examination in case the crops report adversely as to their quality. It is always better to send all samples at once to the Station where they can be directly analyzed or so prepared that they will keep without chemical change.

With the Instructions for Sampling, the Station furnishes a blank form for Description of Sample, a copy of which is here given.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

FORM FOR DESCRIPTION OF SAMPLE.

Station No.............Rec'd at Station,..................18

Each sample of Fertilizer sent for gratuitous analysis must be accompanied by one of these Forms, with the blanks *below* filled out fully and legibly.

The filled out Form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis or statement that acompanies the fertilizer or is used in its sale.

Brand of Fertilizer,..

Name and address of Manufacturer,..............................

....

Name and address of Dealer from whose stock this sample is taken,..

Date of taking this sample, ...

Selling price per ton or hundred, bag or barrel,................

Selling weight claimed for each package weighed,...............

Actual weight of packages opened, ...

Here write a copy of any analysis or guaranteed composition that is fixed to the packages.

....

Signature and P. O. address of person taking and sending the sample.

....

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description" which accompanies it is filed in the Station's Record of Analyses, and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least, under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description," when properly filled out, also contains all the data of cost, weight, etc., of a fertilizer which are necessary for estimating, with help of the analysis, the commercial value of its fertilizing elements, and the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the description may work injustice to the manufacturers or dealers, as well as mislead consumers. It is especially important that the *brand* of a fertilizer and its *selling price* should be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated, and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

When a sample of fertilizer has been analyzed, the results are entered on a printed form, which is filed in the Station Record of Analyses, facing the "Description of Sample" that was received with the fertilizer to which it pertains, and there remains for future reference.

A copy of the analysis is also immediately reported to the party that furnished the sample, the report being entered on one page of another printed form and facing a second printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages, and are, therefore, reproduced here, as follows:

EXPLANATION OF FERTILIZER-ANALYSIS AND VALUATION.

Nitrogen is commercially the most valuable fertilizing element. It occurs in various forms or states. *Organic nitrogen* is the nitrogen of animal and vegetable matters generally, existing in the albumen and fibrin of meat and blood, in the uric acid of bird dung, in the urea and hippuric acid of urine, and in a number of other substances. Some forms of organic nitrogen, as that of blood and meat, are highly active as fertilizers; others, as that of hair and leather, are comparatively slow in their effect on vegetation unless these matters are reduced to a fine powder or chemically disintegrated. *Ammonia* and *nitric acid* are results of the alteration of *organic nitrogen* in the soil and manure heap, and are the most active forms of nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda.

Seventeen parts of ammonia, or 66 parts of pure sulphate of ammonia, contain 14 parts of nitrogen.

Eighty-five parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of superphosphates, in which it is produced by acting on "insoluble" or "reverted" phosphates with oil of vitriol. It is not only readily taken up by plants, but is distributed through the soil by rains. Once well incorporated with soil, it shortly becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *phosphoric acid* strictly means phosphoric acid that was once freely soluble in water, but from chemical change has become insoluble in that liquid. It is freely taken up by a strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity.* "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops, but generally have less value than soluble phosphoric acid, because they do not distribute freely by rain.

Insoluble phosphoric acid implies various phosphates not freely soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be rapidly available as plant food. This is true of South Carolina rock phosphate, of Navassa phosphate, and especially of Canada apatite. The phosphate of coarse raw bones is at first nearly insoluble in this sense, because of the animal matter of the bone which envelopes it, but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

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*To determine "reverted phosphoric acid," this Station continues to employ the method first described by Fresenius, Neubauer and Luck (known in this country also as the Washington method, because adopted by the Convention of Agricultural Chemists, held at Washington, in July, 1880), modified in a single particular, viz: manufactured phosphates are not pulverized.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It is most costly in the form of sulphate, and cheapest in the shape of muriate or chloride.

The valuation of a fertilizer signifies estimating its worth in money, or its trade value; a value which, it should be remembered, is not *necessarily* proportional to its fertilizing effects in any special case.

Plaster, lime, stable manure, and nearly all the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition; but guanos, superphosphates and other fertilizers, for which $30 to $80 per ton are paid, depend chiefly for their trade value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money value per pound of these ingredients is easily estimated from the market prices of the standard articles which furnish them to commerce.

The average trade values, or cost in market per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the Connecticut and New York markets, and employed by the Station during the last three years, have been as follows:

TRADE-VALUES FOR 1881, 1882 AND 1883.

	1881.	1882.	1883.
	—Cents	per	pound.—
NITROGEN in nitrates,	26	26	20
" in ammonia salts,	22½	29	26
" in Peruvian Guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures	20	24	23
" in coarse or moist blood, meat or tankage, in cotton seed, linseed and Castor Pomace,	16	18	18
" in fine ground bone, horn and wool dust,	15	17	17
" in fine medium bone,	14	15	15
" in medium bone,	13	14	14
" in coarse medium bone,	12	13	13
" in coarse bone, horn shavings, hair and fish scrap,	11	11	11

	1881.	1882.	1883.
	—Cents per pound.—		
Phosphoric acid soluble in water,	12½	12½	11
" " "reverted" and in Peruvian Guano,	9	9	8
" " insoluble, in fine bone, fish guano and superphosphates,	6	6	6
" " insoluble, in fine medium bone,	5½	5½	5½
" " " in medium bone,	5	5	5
" " " in coarse medium bone,	4½	4½	4½
" " " in coarse bone, bone ash and bone black,	4	4	4
" " insoluble, in fine ground rock phosphate,	3½	3	2¼
Potash in high grade sulphate,	7½	7	7
" in low grade sulphate and kainit,	5½	5	4¼
" in muriate or potassium chloride,	4½	5	4½

These "trade-values" of the elements of fertilizers are not fixed, but vary with the state of the market, and are from time to time subject to revision. They are not exact to the cent or its fraction, because the same article sells cheaper at commercial or manufacturing centers than in country towns, cheaper in large lots than in small, cheaper for cash than on time, These values are high enough to do no injustice to the dealer, and properly interpreted, are accurate enough to serve the object of the consumer.

To Estimate the Value of a Fertilizer we multiply the per cent. of nitrogen, etc., by the trade-value per pound, and that product by 20; we thus get the values per ton of the several ingredients, and adding them together we obtain the total estimated value per ton.

In case of *Ground bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking one one-hundredth of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone. For further particulars, see page 47.

The uses of the "Valuation" are, 1st, to show whether a given lot or brand of fertilizer is worth as a commodity of trade what it costs. If the selling price is no higher than the estimated value, the purchaser may be quite sure that the price is reasonable. If the selling price is but $2 to $3 per ton more than the estimated value, it may still be a fair price; but if the cost per ton is $5 or more over the estimated value, it would be well to look further. 2d, Comparisons of the estimated values and selling prices of a number of fertilizers will generally indicate fairly which is the best for the money. But the "estimated value" is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are estimated from different data.

Experience leads to the conclusion that trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor. It should be remembered that, in an Annual Report, the fluctuations in trade-value that may occur within the year cannot be accurately followed, and the comparisons of estimated values are mostly in retrospect.

The valuations for 1883 were adopted in consultation with Dr. Goessmann, Director of the Massachusetts Agricultural Experiment Station, Prof. Cook, Director of, and Dr. Neale, Chemist to, the New Jersey Agricultural Experiment Station, and have been employed by these gentlemen in their official Reports for 1883.

ANALYSES AND VALUATION OF FERTILIZERS.

The classification of the Fertilizers analyzed in the Station Laboratory from March 1st, to November 1st, 1883, is as follows:

5	native phosphates.
4	bone char.
6	plain (non-nitrogenous) superphosphates.
75	nitrogenous (ammoniated) superphosphates and guanos.*
31	special fertilizers or "formulas."
1	bat guano.
23	bone manures.
8	dry ground fish.
2	nitrate of soda.
2	sulphate of ammonia.
2	dried blood.
1	meat and plaster.
1	slaughter house refuse.
10	castor pomace and cotton-seed meal.
13	potash salts.
1	alkali deposit.
9	plaster.
4	limestone rocks.
1	rock.
2	quick lime.
1	waste slaked lime from paper mill.
2	infusorial earth.
2	ashes of cotton-seed hulls.
4	wood ashes.
3	leached ashes.
1	farm manure.
1	compost.
4	mucks.
219	

Of this number 14 were analyzed for private parties and are not noticed in the following pages, since the results are not of general interest or value.

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* Including "fish and potash."

NATIVE PHOSPHATES.

915. Fine-ground Crude Navassa Phosphate, Navassa Phosphate Co's agent, No. 12 Cliff street, New York. Sampled and sent by J. M. Milbank, Greenfield Hill.

993. Ground Phosphate Rock. Sold by A. E. Scribner & Co., 35 Broadway, N. Y. Sample obtained from Usher & Tinker, Plainville.

ANALYSES.

	915	993
Phosphoric acid soluble in ammonium citrate, ..	4.09	.37
Phosphoric acid insoluble in " " ..	25.81	34.85
Cost per ton, ...	$17.00†	$30.00*

Both of these samples are quite fine and readily pass through a sieve having $\frac{1}{50}$ inch meshes.

BONE CHAR.

Four samples of this material have been analyzed. **873** and **889** were sent to the Station by the purchaser. **1033** and **1042** were obtained from manufacturers in New Haven by the Station. They are all waste materials which have been used for case-hardening iron.

ANALYSES.

	873	889	1033	1042
Water, ...		25.91	2.38	
Carbonic acid, ...	2.15			1.18
Phosphoric acid,............	29.17	28.34	16.63	21.34

This bone char is little more active as a fertilizer than fine ground phosphate rock, when applied directly to land. When properly treated with oil of vitriol, however, it makes an excellent superphosphate. See the following page.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

This class includes fertilizers which are made by treating some phosphate (rock phosphate, bone ash, bone char, etc.), with a very strong acid, usually oil of vitriol, without the addition of nitrogenous matter or potash salts. They are valuable commercially only for the soluble phosphoric acid which they contain.

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* $22.00 per ton wholesale in N. Y.

† f. o. b. in N. Y., $18.00 to $18.50 in Southport.

Six articles of this class have been analyzed.

877. Home Made Superphosphate. Sample taken 48 hours after it was prepared.

890A. Home Made Superphosphate. The same stock as **877**, but taken after it had lain in a pile one week.

890 B. The same after standing six months in a tightly closed jar.

916. Navassa Acid Phosphate. Made by the Navassa Phosphate Co., 12 and 14 Cliff street, New York. Sampled and sent by J. M. Milbank, Greenfield Hill.

942. Acid Phosphate of Lime. Made by the Bowker Fertilizer Co. From stock of Wilson & Burr, Middletown. Sampled and sent by J. M. Hubbard, Middletown.

987. High Grade Superphosphate. Made by the Mapes Formula & Peruvian Guano Co., N. Y. From stock of the Mapes Branch, Hartford. Sampled by the Station Agent.

1036. Packard's Concentrated Superphosphate. Imported by H. J. Baker & Bro., N. Y. Sample sent by the importers at the request of the Station.

ANALYSES.

	877	890A	890B	916	942	987	1036
Phosphoric acid soluble in water,	13.04	14.46	13.15	5.56	10.72	34.94	39.10
Reverted* Phosphoric acid,		3.07		6.43	1.08	1.43	6.70
Insoluble phosphoric acid,				4.55	2.84	1.56	.71
Cost per ton,				$23.00	24.00	70.00	
Cost of soluble phosphoric acid per 100 lbs.,					$11.20†	10.02	
					$9.66‡	9.57	

877 was made from the bone char **873** whose analysis is given on the previous page, in the following way:

100 parts by weight of char were spread in a mortar bed and wet with 42 parts of water. 55 parts of strong oil of vitriol, "66° acid," were then added and the whole was thoroughly mixed with a hoe. The solvent action of the oil of vitriol contin-

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* See page 23.

† Making no allowance for reverted and insoluble phosphoric acid.

‡ Allowing 8c. per lb. for reverted and 2½c. for insoluble phosphoric acid.

ued for some time, as is shown by the higher percentage of soluble phosphoric acid in the material after lying for a week. As far as concerns its mechanical condition the superphosphate prepared as above was inferior to the best "acid phosphates" in our market. It was somewhat lumpy and could not be conveniently drilled without sifting. The lumps were very soft, however, and easily pulverized. Constant stirring with a hoe while the mixture is cooling does much to prevent the forming of lumps. In this case the operation was decidedly economical, for by it soluble phosphoric acid was got for about $8.00 per 100 lbs., while in market it was selling for from $10 to $12, and its fertilizing effect was satisfactory. Generally speaking the farmer can buy acid phosphate cheaper than he can make it. Home manufacture is only advisable when farm work is slack and the raw phosphate can be got at a very low price.

Ground bone is used considerably in case-hardening small articles of iron, and where the consumption is not large, manufacturers throw away the spent char, or will sell it at a low price. Such material it may be very profitable to utilize for superphosphate manufacture on the farm.

916 is made from the Navassa rock which contains much iron and alumina. A larger share of the phosphoric acid may have been soluble in water when the goods were first manufactured, but if so, a portion has reverted, or been made again insoluble in water. This effect is with great probability attributed to the iron and alumina present.

987 contains more than double the amount of soluble phosphoric acid usually found in high grade superphosphates and at $70 per ton retail we believe is the cheapest source of soluble phosphoric acid in our market. **1036** is an article of still higher grade than the last mentioned, but is not in the retail trade. **987** is manufactured in this country, **1036** is imported from England.

NITROGENOUS (AMMONIATED) SUPERPHOSPHATES AND GUANOS.

Here are included all those superphosphates which contain nitrogen in any form—excepting the formulas or "special manures," to be noticed in the next section—as well as guanos, either in their natural state or manipulated. The articles of this class with few exceptions also contain more or less potash and such are known as "complete manures."

75 samples of this class of fertilizers have been analyzed during the year, 7 of them for private parties. The analyses and valuations of 63 of them are given on pages 33 to 38.

34 are called by the manufacturers "phosphate" or "superphosphate;" 10, "Fish and Potash;" 4, "Mineral Manure;" 3, "Peruvian Guano;" 3, "Complete Manure," and 2, "Common Sense Fertilizer." The other 12 are "Alkalized Guano," "Menhaden Guano," "Fish Guano," "Sea Fowl Guano," "Blood Guano," "Soluble Pacific Guano," "Animal Fertilizer," "Pelican Bone Fertilizer," "Farmer's Friend Fertilizer," "Bay State Fertilizer" and "Great Planet A."

On page 38 are given the analyses of 5 superphosphates, whose retail prices were not reported. For that reason the analyses could not be arranged with reference to the relation of cost to estimated value as the others have been.

Chlorine has been determined in most cases in order to decide whether the potash in the fertilizer exists as muriate or sulphate. Potash is in all cases reckoned as muriate if sufficient chlorine is present in the fertilizer to combine with it. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned as sulphate.

998 "Alkalized Guano" is stated by the manufacturers to be an artificial guano made of ammonia salts, sulphate of potash and phosphoric acid "from organic sources." That portion of the guano which is insoluble in water has much the appearance of the phosphates that come from the West Indies, Curaçao, Mona Island, etc.

863 Chittenden's Fish and Potash is made from fish scrap which has not been acidulated. For that reason, only nitrogen and total phosphoric acid were determined at the time when the sample came, and the results were published in Bulletin No. 73, p. 13. The valuation then given was $25.20. For comparison with other brands of fish and potash it was necessary to separately determine phosphoric acid in the three forms and to change the valuation accordingly, which has been done in the table on page 37.

855, 856, 875 and **948** are samples of Paul Thompson's Mineral Manure for Tobacco and Other Crops. **856** was sampled and sent by W. A. Burr, West Hartford. The others were sampled by the manufacturer and the station agent. The analyses indicate a series of unsuccessful experiments in manufacture, and not a marketable article of tolerably uniform composition.

ANALYSES AND VALUATIONS.

Station No.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	*Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Estimated value per ton.	Cost per ton.
875		1.14	2.63	.84	.39	.25	17.26	25.00
948		.80	.16	1.12	.38	1.31	10.56	25.00
855	.08	.19	none	1.76	.72	.16	5.19	25.00
856		.29		2.51				

The average cost of the nitrogenous superphosphates excluding the four just mentioned, is $41.42; the average estimated value is $34.92, and the average difference between cost and valuation is $6.50.

For the last four years the average cost and the average difference between cost and estimated value have been as follows:

	1880.	1881.	1882.	1883.
Average cost,	$39.00	43.00	40.58	41.42
Average difference,	$3.00	4.00	1.89	6.50

Since the trade values used by the Station in computing estimated values have been prepared yearly from the market reports and always in the same manner this larger discrepancy in the present year between cost and valuation cannot be due to any arbitrary change in our trade values. It is most likely explained by the fact that the prices of manufactured goods have not gone down during the last eighteen months while many of the raw materials used in their manufacture have been steadily becoming cheaper. A further discussion of this matter will be found in the Review of the Fertilizer Market.

About one-third (23) of the samples have not contained the full minimum amounts of nitrogen, phosphoric acid and potash, guaranteed by the makers. In most cases, however, the difference between the composition and guarantee was quite small and only involved a single ingredient.

The Comparison of Different Superphosphates of the Same Brand and of the Analyses with the Guarantees, on pages 39 to 43, serves to show first the variations in samples of the same brand which are caused by carelessness in the preparation of the goods or in their storage, errors in sampling, etc., and second, how nearly the actual composition of the superphosphates agrees with what is claimed for them by their manufacturers.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
964	Peruvian Guano.		Mapes F. & P. G. Co., N. Y.	C. H. Cables, Thomaston.
998	Alkalized Guano.	Hurtado & Co., New York.	Southmayd & Gardiner, Middletown.	Station Agent.
921	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	John S. Morgan, Groton.	B. A. Copp, Groton.
912	Menhaden Guano.	Jas. Church & Co., Tiverton, R. I.	Manufacturers.	Geo. D. Harrison, Lakeville.
969	Pure Bone Phosphate.	G. H. Harris & Son, Eagleville.	"	Station Agent.
1011	Darling's Animal Fertilizer.	L. B. Darling & Co., Pautucket, R. I.	T. P. Pease & Sons' Co., Windsor Locks.	" "
918	Mapes' Complete Manure ("A" Brand)	Mapes F. & P. G. Co., N. Y. City.	Mapes F. & P. G. Co's Branch, Hartford.	" "
954	Ammon. Dissolved Bone Phosphate.	Lister Bros., Newark, N. J.	R. B. Bradley & Co., N. Haven.	" "
961	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	F. Ellsworth, Hartford.	" "
924	E. Frank Coe's Ammon. Bone Super.	E. Frank Coe, New York.		Andrew Kingsbury, Coventry.
962	Original Coe's Superphos. of Lime.	Wm. Bradley, Boston, Mass.	T. P. Pease & Sons' Co.. Windsor Locks.	Station Agent.
991	World of Good Ammoniated Bone Superphosphate.	Thompson & Edwards, Chicago, Ill.	John S. Wells, Hebron.	" "
885	Fish and Potash, Crossed Fishes Brand.	Quinnipiac Fertilizer Co., New London.	Raymond Bros., Norwalk.	" "
974	Mapes' Complete Manure.	Mapes F. & P. G. Co., N. Y. City.	R. B. Bradley & Co., N. Haven.	" "
922	Bradley's Superphosphate.	Bradley Fertilizer Co., Boston.	Smith & Sons.	T. S. Gold, West Cornwall.
1013	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Homer C. Roberts, Silver Lane.
1001	G. W. Miles' Fish Fertilizer and Potash.	Geo. W. Miles Co., Milford.	S. J. Hall, Meriden.	Station Agent.
971	Bosworth Bros. Superphos. of Lime.	Bosworth Bros., Putnam.	J. A. Paine, Danielsonville	" "
886	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Raymond Bros., Norwalk.	" "
1015	Fish and Potash, Crossed Fishes Brand.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Olin Wheeler, Buckland.
957	Pelican Bone Fertilizer.	H. J. Baker & Bro., N. Y. City.	S. J. Hall, Meriden.	Station Agent.

NITROGENOUS SUPERPHOSPHATES.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
904	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., N. Y. City.	Tolles & McEwen, Naugatuck.	Station Agent.
1005	G. W. Miles' I. X. L. Ammoniated Bone Superphosphate.	Geo. W. Miles & Co., Milford.	S. J. Hall, Meriden.	" "
955	Americus Brand Ammoniated Bone Superphosphate.	Williams, Clark & Co., New York.	F. Ellsworth, Hartford.	" "
967	Fish and Potash, Plain Brand.	Quinnipiac Fertilizer Co., New London.	A. W. Allen, Jr., Thompsonville.	" "
920	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., New York.	W. R. Perry & Co., N. London.	C. A. Copp, Groton.
868	Bradley's Superphosphate of Lime.	Bradley Fertilizer Co., Boston.	Raymond & Bro., So. Norwalk.	F. Sherwood, Green's Farms.
1023	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
952	Ammoniated Bone Superphosphate.	Preston Fertilizer Co., Greenpoint, L. I.	J. B. Merrow & Sons, Merrow.	" "
869	Baker's A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., New York.	John Alvord, Green's Farms.	F. Sherwood, Green's Farms.
982	Great Planet Brand "A."	Clark's Cove Guano Co., New Bedford, Mass.	Manufacturer.	Manufacturer.
956	The Long Islander Ammoniated Superphosphate of Lime with Potash.	Atlantic & Virginia Fertilizer Co., Orient, L. I., and Richmond, Va.	S. J. Hall, Meriden.	Station Agent.
925	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	W. B. Williams, Bolton Centre.	Andrew Kingsbury, Coventry.
898	Ammoniated Bone Superphosphate.	Geo. W. Miles Co., Milford.	Apothecaries' Hall, Waterbury.	Station Agent.
887	Soluble Pacific Guano.	Glidden & Curtis, Boston, Mass.	Raymond Bros., Norwalk.	" "
997	Bowker's Dissolved Bone.	Bowker Fertilizer Co., Boston and New York.	J. A. Paine, Danielsonville.	" "
927	Farmer's Friend Fertilizer.	Read & Co., New York.	A. C. Sternburg, Hartford.	" "
900	Bowker's Fish and Potash.	Bowker Fertilizer Co., New York.	Curtis & Abbott, Birmingham.	" "
988	No. 1 Peruvian Guano, Standard.	Hurtado & Co., New York.	Southmayd & Gardiner, Middletown.	" "
863	Chittenden's Fish and Potash.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	" "
897	Geo. W. Miles' Fish and Potash.	Geo. W. Miles Co., Milford.	Apothecaries' Hall, Waterbury.	" "
893	Russell Coe's Ammoniated Bone Superphosphate.	Russell Coe, Linden, N. J.	Curtis & Abbott, Birmingham.	" "

NITROGENOUS SUPERPHOSPHATES.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
891	Chittenden's Universal Phosphate.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	Station Agent.
958	The Orient Complete Manure.	Atlantic & Virginia Fertilizer Co., Orient, L. I., and Richmond, Va.	W. C. Reynolds, East Haddam.	" "
866	Chittenden's Ammoniated Bone Superphosphate.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	" "
1010	Chittenden's Fish and Potash.	" " "	Southmayd & Gardiner, Middletown.	" "
977	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	" "
923	Ammoniated Bone Superphosphate.	Russell Coe, Linden, N. J.	Smith & Sons, W. Cornwall.	T. S. Gold, West Cornwall.
896	" " "	Buffalo Fertilizer and Chemical Works.	Ruggles & Clark, Shelton.	Station Agent.
983	Dole Common Sense Fertilizer, No. 3.	Dole Common Sense Fertilizer Co., Boston, Mass.	Manufacturer.	Manufacturer.
901	Brighton Phosphate.	Bowker Fertilizer Co., N. Y. City.	Curtis & Abbott, Birmingham.	Station Agent.
960	Cook's Blood Guano.	Manhattan Chemical Co., N. Y.	A. C. Sternburg, Hartford.	" "
907	New Haven Fertilizer Co's Superphosphate.	New Haven Fertilizer Co.	Manufacturer.	" "
999	No. 1 Peruvian Guano, Lobos.	Hobson, Hurtado & Co, 63 Pine street, New York, Importers.	Southmayd & Gardiner, Middletown.	" "
861	Raw Bone Superphosphate.	G. W. Miller, Middlefield.	Manufacturer.	Jas. H. Barker, Branford.
1008	" Superphosphate.	" " "	C. E. Chapman, Westbrook.	Station Agent.
984	Dole's Common Sense Fertilizer, No. 2.	Dole Common Sense Fertilizer Co., Boston, Mass.	Manufacturer.	Manufacturer.
994	Mitchell's Standard Superphosphate.	Mitchell Standard Works, Linden, N. J.	John A. Paine, Danielsonville.	Station Agent.
980	Bradley Fertilizer Co's Sea Fowl Guano.	Bradley Fertilizer Co., Boston.	Manufacturer.	Manufacturer.
846	G. W. Miles Co's I. X. L. Phosphate.	Geo. W. Miles Co., Milford.	"	"
844	G. W. Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.	"	"
845	"C." Island Dry Fish Guano.	G. W. Miles Co., Milford.	"	"
847	G. W. Miles Co's Fish and Potash, XX.	" " "	"	"

NITROGENOUS SUPERPHOSPHATES.

Station No.	NAME.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.*	Insoluble Phos. Acid.	Potash.	Chlorine.	Esti-mated value per ton.	Cost per ton.	Valu-ation exceeds Cost.
964	Mapes Peruvian Guano	.15	3.18	1.57	5.73	6.38	10.00	5.37	2.40	$64.95	$54.00*	$10.95
998	Hurtado & Co's Alkalized Guano	.14	6.[illegible]3	.15	.61	5.33	8.20	5.28	1.25	61.40	60.00	1.40
921	Quinnipiac Fertilizer Co's Phosphate	.64	....	2.85	7.47	2.28	1.75	2.66	2.34	40.11	40.00	.11
912	James Church & Co's Menhaden Guano	....	....	4.96	1.83	3 24	1.10	.29	....	33.60	33.60	
												Cost exceeds valuation.
969	Harris' Pure Bone Phosphate	....	....	2.92	5.54	3.19	5.73	....	....	37.60	38.00	$0.40
1011	L. B. Darling & Co's Animal Fertilizer	..	.47	3.44	1.19	5.26	8.71	4 68	3.50	43.73	45.00	1.27
918	Mapes' Complete Manure ("A" Brand)	.66	.72	1.30	7.58	2.91	3.22	2.89	1.98	40.16	42.00	1.84
954	Lister Bro's Ammoniated Dissolved Bone Phosphate	....	....	1.69	9.76	.98	.94	1.89	2.02	33.55	35.00	1.45
961	Clark's Cove Guano Co's Bay State Fertilizer	.96	.76	1.13	8.99	.95	1.11	3.08	3.09	38.24	40.00	1.76
924	E. Frank Coe's Ammoniated Bone Superphosphate	....	....	2.19	7.31	2.22	3.73	....	....	34.18	36.00	1.82
962	Wm. Bradley's Original Coe's Superphosphate of Lime	.50	.20	2.11	8.61	1.37	3.06	.31	.24	37.81	40.00	2.19
991	World of Good Ammoniated Bone Superphosphate	....	....	1.90	8.59	1.74	3.62	....	....	34.76	37.00	2.24
885	Quinnipiac Fertilizer Co's Fish and Potash, Crossed Fishes Brand	1 38	.44	2.48	.83	4.12	3.62	4.38	7.31	35.70	38.00	2.30
974	Mapes Complete Manure (for light or sandy soil)	1.42	2.63	1.24	6.01	1.83	1.12	6.61	.41	51.51	54.00	2.49
922	Bradley Fertilizer Co's Superphosphate	.32	....	2.47	8.22	1.19	2.44	1.89	1.87	37.16	40.00	2.84
1013	Quinnipiac Fertilizer Co's Phosphate	....	1.68	1.80	5.15	1.78	2.48	2.77	....	36.53	40.00	3.47
1001	G. W. Miles' Fish Fertilizer and Potash	....	.25	2.49	3.88	1.63	1.94	3.84	3.47	29.49	33.00	3.51
971	Bosworth Bros' Superphosphate of Lime	....	.09	1.74	4.84	3.67	7.90	2.23	2.02	36.37	40.00	3.63
886	Quinnipiac Fertilizer Co's Phosphate	....	.52	2.48	5.81	3.11	2.31	2.02	2.15	36.36	40.00	3.64
1015	Quinnipiac Fertilizer Co's Fish and Potash (Crossed Fishes Brand)	....	1.48	2.60	.60	4.78	3.02	4.72	....	36.26	40.00	3.74
957	H. J. Baker & Bro's Pelican Bone Fertilizer	....	1.08	1.10	7.09	1.26	.56	2.65	4.10	31.21	35.00	3.79

* $49.00 per ton in New York, in 5 ton lots. † See page 23.

NITROGENOUS SUPERPHOSPHATES.—*Continued.*

Station No.	NAME.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.*	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds valuation.
904	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	....	1.88	.76	9.88	.17	.36	2.58	3.30	$37.91	$42.00	$4.09
1005	Geo. W. Miles' I. X. L. Ammoniated Bone Superphosphate	....	.37	1.67	7.23	1.09	3.29	1.93	1.26	32.84	37.00	4.16
955	Williams, Clark & Co's Americus Brand Ammoniated Bone Superphos.	....	....	2.27	7.03	1.06	4.98	2.38	2.28	35.60	40.00	4.40
967	Quinnipiac Fertilizer Co's Fish and Potash, Plain Brand	....	.44	2.14	.70	4.44	4.05	5.35	7.91	30.18	35.00	4.82
920	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	...	1.99	.72	8.81	.68	.47	2.78	3.71	37.05	42.00	4.95
868	Bradley Fertilizer Co's Superphosphate of Lime	.45	....	2.33	7.97	1.30	2.56	1.97	1.77	36.88	42.00	5.12
1028	Quinnipiac Fertilizer Co's Phosphate	....	.51	2.45	5.75	1.97	2.03	2.89	..	34.62	40.00	5.38
952	Ammoniated Bone Superphosphate (Preston's)	....	.45	1.50	6.46	1.19	3.31	1.08	2.18	30.24	36.00	5.76
869	H. J. Baker & Bro's A. A. Ammoniated Superphosphate	....	1.92	.56	8.52	59	.64	2.88	3.91	35.46	42.00	6.54
982	Clark's Cove Guano Co's Great Planet Brand "A"	.09	1.46	1.53	6.75	.31	1.81	8.90	4.89	41.40	48.00	6 60
956	Atlantic & Virginia Fertilizer Co's Ammoniated Superphos. of Lime	....	....	.99	6.98	1.78	2.57	5.31	4.65	30.35	37.00	6.65
925	Quinnipiac Fertilizer Co's Phosphate	.90	....	1.87	2.66	5.98	3.19	2.18	2 94	33.30	40.00	6.70
898	Geo. W. Miles Co's Ammoniated Bone Superphosphate	....	....	2.26	7.03	1.25	3.07	1.84	2.75	33.11	40.00	6.89
887	Glidden & Curtis' Soluble Pacific Guano	.61	.17	1.82	5.08	1.73	5.66	2.54	2.60	34.59	42.00	7.41
997	Bowker's Dissolved Bone	....	.14	1.53	7.44	.85	2.10	2.73	3.93	30.34	38.00	7.66
927	Read & Co's Farmers' Friend Fertilizer	1.14	....	1.03	7.07	.94	1.93	1.48	3.18	29.93	38.00	8.07
900	Bowker Fertilizer Co's Fish and Potash	....	...	2.52	2.85	2.46	2.10	4.08	9.20	27.79	36.00	8.21
988	Hurtado & Co's No. 1, Peruvian Guano Standard	.11	7.36	.74	5.14	2.68	4.81	.90	1.26	64.24	73.00	8.76
863	Chittenden's Fish and Potash	....	....	2.92	.26	4.38	1.85	4.67	8.57	27.20	36.00	8.80
897	Geo. W. Miles' Fish and Potash	....	....	2.64	4.69	1.15	2.69	3.68	4.90	30.66	40.00	9.34
893	Russell Coe's Ammoniated Bone Superphosphate	...	....	2.60	6.56	.78	1.42	1.20	4.52	30.36	40.00	9.64
891	Chittenden's Universal Phosphate	.68	....	1.81	7.55	.87	.88	2.60	4.37	32.26	42.00	9.74
958	Atlantic & Virginia Fertilizer Co's Orient Complete Manure	....	....	.93	7.34	1.73	2.97	1.51	3.57	28.04	38.00	9.96
866	Chittenden's Ammoniated Bone Superphosphate	....	....	1.74	5.19	1.21	2.14	2.38	4.40	25.94	36.00	10.06
1010	Chittenden's Fish and Potash	....	....	2.48	.37	2.60	3.46	4.91	3.38	24.94	36.00	11.06
977	Bowker Fertilizer Co's Hill and Drill Phosphate	....	.19	1.62	5.40	1.77	3.58	1.59	2.93	28.80	40.00	11.20

* See page 23.

NITROGENOUS SUPERPHOSPHATES.—*Continued.*

Station No.	NAME.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.*	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds valuation.
923	Russell Coe's Ammoniated Bone Superphosphate	....	....	2.00	6.63	1.20	1.58	1.27	2.43	$28.69	$40.00	$11.31
896	Buffalo Fertilizer and Chemical Works' Ammoniated Bone Superphos.	....	....	2.87	6.20	1.18	3.14	1.16	1.35	33.49	45.00	11.51
983	Dole's Common Sense Fertilizer, No. 3	....	.43	2.21	.97	4.26	1.26	4.93	4.43	27.06	40.00	12.94
901	Bowker Fertilizer Co's Brighton Phosphate	....	....	1.37	6.90	1.20	1.61	1.71	3.72	26.78	40.00	13.22
960	Cook's Blood Guano	....	1.05	.74	5.84	1.56	.91	1.48	1.72	26.56	40.00	13.44
907	New Haven Fertilizer Co's Superphosphate	1.18	....	.93	5.59	.88	2.87	1.98	1.22	27.83	42.00	14.17
999	Hurtado & Co's No. 1, Peruvian Guano, Lobos	....	3.63	.74	.99	6.82	9.28	1.88	.86	48.52	63.00	14.48
861	G. W. Miller's Raw Bone Superphosphate	....	....	2.80	3.16	3.57	4.10	5.13	....	34.82	50.00	15.18
1008	G. W. Miller's Raw Bone Superphosphate	....	....	2.88	2.80	3.29	4.08	5.86	5.53	34.55	50.00	15.45
984	Dole's Common Sense Fertilizer, No. 2	....	.70	.65	.55	3.51	2.16	2.69	2.61	18.34	35.00	16.66
994	Mitchell's Standard Superphosphate	....	.10	.86	5.97	.90	1.33	2.85	7.87	23.07	40.00	16.93
980	B. D. Sea Fowl Guano	....	.76	1.89	7.31	1.44	2.48	3.35	3.39	36.85	......	......
846	Geo. W. Miles Co's I. X. L. Phosphate	....	....	2.04	7.11	.75	3.51	1.61	....	31.80	......	......
844	G. W. Miller's Raw Bone Phosphate	....	3.74	3.08	2.80	3 21	2.80	5.91	....	33.84	......	......
845	G. W. Miles Co's "C" Island Dry Fish Guano	....	....	4.32	2 47	3.09	2.09	2.52	....	34.89	......	......
847	G. W. Miles Co's Fish and Potash, XX	....	....	2.89	4.81	1.55	2.11	3.60	....	31.94	......	......

* See page 23.

COMPARISON OF ANALYSES OF SUPERPHOSPHATES OF THE SAME BRAND, AND OF THE ANALYSES WITH THE GUARANTEE.

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid			Potash.
				Soluble.	Reverted.†	Insoluble.	
	Baker's A. A. Superphosphate	Guaranteed	2.5-3.3	10-12			2-3
904		Found	2.6	9.9	.2	.4	2.6
920			2.7	8.8	.7	.5	2.8
869			2.5	8.5	.6	.6	2.9
	Bradley's Superphosphate	Guaranteed	2.3-3.1	7-10		2-3	1.5-2.5
922		Found	2.8	8.2	1.2	2.4	1.9
868			2.8	8.0	1.3	2.6	2.0
	Chittenden's Fish and Potash	Guaranteed	2.5-4.1	6-8*			4-6
863		Found	2.9	.3	4.4	1.9	4.7
1010			2.5	.4	2.6	3.5	4.9
	Miles Co's Fish and Potash	Guaranteed	2.5-3.5	5-8			3-5
1001		Found	2.7	3.9	1.6	1.9	3.8
897			2.6	4.7	1.2	2.7	3.7
847			2.9	4.8	1.6	2.1	3.6
	Miles Co's Superphosphate	Guaratneed	2-3	8-12			1-3
1005		Found	2.0	7.0	1.1	3.1	1.9
898			2.3	7.0	1.3	3.1	1.8
846			2.0	7.1	.8	3.5	1.6
	Miller's Superphosphate	Guaranteed	3.1	6.0		2.8	5.9
1008		Found	2.9	2.8	3.3	4.1	5.9
861			2.8	3.2	3.6	4.1	5.1
844			3.1	2.8	3.2	2.8	5.9

* Total Phosphoric Acid. † See page 23.

COMPARISON OF ANALYSES OF SUPERPHOSPHATES OF THE SAME BRAND, AND OF THE ANALYSES WITH THE GUARANTEE—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid Soluble.	Phosphoric Acid Reverted.‡	Phosphoric Acid Insoluble.	Potash.
		Guaranteed	**2.5–3.5**	**8–10**		**1–3**	**2–3**
921	Quinnipiac Fertilizer Co's Phosphate	Found	3.5	7.5	2.3	1.8	2.7
886			3.0	5.8	3.1	2.3	2.0
1023			3.0	5.8	2.0	2.0	2.9
1013			3.5	5.2	1.8	2.5	2.8
925			2.8	2.7	6.0	3.2	2.2
		Guaranteed	**3.3–4.3**	**3–5**		**2.0**	**3–5**
885	Quinnipiac Fish and Potash	Found	4.3	.8	4.1	3.6	4.4
1015			4.1	.6	4.8	3.0	4.7
		Guaranteed	**1.7–2.7**	**10–12**		**3**	***2½–4**
923	Russell Coe's Superphosphate	Found	2.0	6.6	1.2	1.6	1.3
893			2.6	6.6	.8	1.4	1.2

COMPARISON OF THE ANALYSES OF NITROGENOUS SUPERPHOSPHATES WITH THE GUARANTEE.

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid Soluble.	Phosphoric Acid Reverted.‡	Phosphoric Acid Insoluble.	Potash.
891	Chittenden's Universal Phosphate	Guaranteed	**2–2.9**	**8–10**			**2–4**
		Found	2.5	7.6	.9	.8	2.6
866	Chittenden's Ammoniated Bone Superphosphate	Guaranteed	**1.6–2.5**	**6–8**		**2**	**2–3**
		Found	1.7	5.2	1.2	2.1	2.4
1011	Darling & Co's Animal Fertilizer	Guaranteed	**4–6**			**10–12†**	**5–6**
		Found	3.9	1.2	5.3	8.7	4.7

* As Sulphate. † Total Phosphoric Acid. ‡ See page 23.

COMPARISON OF THE ANALYSES OF NITROGENOUS SUPERPHOSPHATES WITH THE GUARANTEE—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid			Potash.
				Soluble.	Reverted.†	Insoluble.	
984	Dole's Common Sense Fertilizer, No. 2	Guaranteed	3–6			4–6*	3–5
		Found	1.4	.6	3.5	2.2	2.7
983	Dole's Common Sense Fertilizer, No. 3	Guaranteed	3–6			5–7*	4–6
		Found	2.6	1.0	4.3	1.3	4.9
924	E. Frank Coe's Ammoniated Bone Superphosphate	Guaranteed	1.6–2.5	9–12		2–3	
		Found	2.2	7.3	2.2	3.7	
887	Glidden & Curtis' Soluble Pacific Guano	Guaranteed	2–3	8–11			2–3.5
		Found	2.0	5.1	1.7	5.7	2.5
969	Harris' Pure Bone Phosphate	Guaranteed	2.9	4.9	7.1	2.7	
		Found	2.9	5.5	3.2	5.7	
998	Hurtado & Co's Alkalized Guano	Guaranteed	6.6–7.4			13–15*	5
		Found	6.8	.6	5.3	8.2	5.3
988	Hurtado & Co's No. 1 Peruvian Guano, Standard	Guaranteed					
		Found	8.1	5.1	2.7	4.8	.9
999	Hurtado & Co's No. 1 Peruvian Guano, Lobos	Guaranteed	4.9				
		Found	4.4	1.0	6.8	9.3	1.9
954	Lister Bros. Ammoniated Dissolved Bone Phosphate	Guaranteed	1.6–2	8–10		2–3	1.5–2
		Found	1.7	9.8	1.0	.9	1.9
964	Mapes' Peruvian Guano	Guaranteed					
		Found	4.9	5.7	6.4	10.	5.4
918	Mapes' Complete Manure ("A" Brand)	Guaranteed	2.5–3.3	10–12		2–4	2.5–3.5
		Found	2.7	7.6	2.9	3.2	2.9
974	Mapes' Complete Manure (for light or sandy soils)	Guaranteed	5–6.6			7–9*	6–8
		Found	5.3	6.0	1.8	1.1	6.6

* Total Phosphoric Acid. † See page 23.

COMPARISON OF THE ANALYSES OF NITROGENOUS SUPERPHOSPHATES WITH THE GUARANTEE—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid Soluble.	Phosphoric Acid Reverted.‡	Phosphoric Acid Insoluble.	Potash.
994	Mitchell's Standard Superphosphate	Guaranteed	**1.6–2.9**			**8–10***	**2–3**
		Found	1.0	6.0	.9	1.3	2.9
956	Atlantic & Virg. Fert. Co's Ammon. Superphos. of Lime.	Guaranteed	**.8–1.6**	**8–11**		**2–3**	**5.7**
		Found	1.0	7.0	1.8	2.6	5.3
958	Atlantic & Virginia Fert. Co's Orient Complete Manure.	Guaranteed	**1.6**	**8**			**1**
		Found	.9	7.3	1.7	3.0	1.5
971	Bosworth Bro's Superphosphate of Lime	Guaranteed	**2–2.5**	**11–13**		**2–5**	**2–3**
		Found	1.8	4.8	3.7	7.9	2.2
997	Bowker's Dissolved Bone	Guaranteed	**1.6–2.5**	**8–10**		**2**	**2–4†**
		Found	1.7	7.4	.9	2.1	2.7
900	Bowker Fertilizer Co's Fish and Potash	Guaranteed	**2.5–3.5**			**8–10***	**4–6**
		Found	2.5	2.9	2.5	2.1	4.1
977	Bowker Fertilizer Co's Hill and Drill Phosphate	Guaranteed	**2–2.9**	**8–10**		**2**	**2–4†**
		Found	1.8	5.4	1.8	3.6	1.6
901	Bowker Fertilizer Co's Brighton Phosphate	Guaranteed	**1.6–2.5**	**7–9**		**2**	**4–6†**
		Found	1·4	6.9	1.2	1.6	1.7
896	Buffalo Fertilizer Co's Ammoniated Bone Superphosphate,	Guaranteed	**2.5–3.5**	**8–10**		**1–2**	**2–3†**
		Found	2.9	6.2	1.2	3.1	1.2
980	B. D. Sea Fowl Guano	Guaranteed	**2.5–3.2**	**7–8**	**2–3**	**2–3**	**2–3**
		Found	2.7	7.3	1.4	2.5	3.4
962	Bradley's Original Coe's Superphosphate of Lime	Guaranteed	**2.1–2.9**	**7–8**	**2–3**	**2–3**	
		Found	2.8	8.6	1.4	3.1	.3
957	Baker's Pelican Bone Fertilizer	Guaranteed	**1.8–2.3**	**8–10**			**2.2–2.7**
		Found	2.2	7.1	1.3	.6	2.7

* Total Phosphoric Acid. † As Sulphate. ‡ See page 23,

COMPARISON OF THE ANALYSES OF NITROGENOUS SUPERPHOSPHATES WITH THE GUARANTEE—*Continued.*

Station No.	Name or Brand.		Nitrogen.	Phosphoric Acid			Potash.
				Soluble.	Reverted.†	Insoluble.	
912	Church & Co's Menhaden Guano	Guaranteed	**4.7**	**4.9**			**.3**
		Found	5.0	1.8	3.2	1.1	.3
961	Clark's Cove Guano Co's Bay State Fertilizer	Guaranteed	**2.1–2.8**	**8–11**		**3**	**2–3**
		Found	2.9	9.0	1.0	1.1	3.1
982	Clark's Cove Guano Co's Great Planet Brand "A"	Guaranteed	**2.5–3.3**	**7–8**			**9–11**
		Found	3.1	6.8	.3	1.8	8.9
900	Cook's Blood Guano	Guaranteed	**1.6–2.5**	**7**		**3**	
		Found	1.8	5.8	1.6	.9	1.5
845	Miles Co's "C" Island Dry Fish Guano	Guaranteed					
		Found	4.3	2.5	3.1	2.1	
907	New Haven Fertilizer Co's Superphosphate	Guaranteed					
		Found	2.1	5.6	.9	2.9	2.0
952	Preston's Ammoniated Superphosphate	Guaranteed	**2.5–3.5**	**10–12**		**1–2**	**2**
		Found	2.0	6.5	1.2	3.3	1.1
967	Quinnipiac Fertilizer Co's Fish and Potash (plain brand)	Guaranteed	**2–3**	**4–6**		**2**	**4–6**
		Found	2.6	.7	4.4	4.1	5.4
927	Read & Co's Farmer's Friend Fertilizer	Guaranteed	**1.6–2**	**8–10**		**2**	**.8–1**
		Found	2.2	7.1	.9	2.0	1.5
991	World of Good Ammoniated Bone Superphosphate	Guaranteed	**1.6–2**	**8–10**		**2**	
		Found	1.9	8.6	1.7	3.6	
955	Williams, Clark & Co's Ammoniated Bone Superphos.	Guaranteed	**1.6–2.5**	**6–8**	**3–4**	**1–3**	**1–2**
		Found	2.3	7.0	1.1	5.0	2.4

† See page 23.

SPECIAL FERTILIZERS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
972	Tobacco Manure (for use with stems).	Mapes' F. & P. G. Co., New York.	Mapes' F. & P. G. Co's Br'ch, Hart.	Station Agent.
965	Complete Tobacco Manure.	H. J. Baker & Bro., "	----------------------------	" "
1043	Chittenden's Fertilizer for Corn and other Grain.	Nat'l Fertilizer Co., Bridgeport.	John S. Kirkham, Newington.	Dealer.
992	Grass Manure.	H. J. Baker & Bro., New York.	Olds & Whipple, Hartford.	Station Agent.
975	Potato Manure.	Mapes' F. & P. G. Co., "	R. B. Bradley & Co. N. Haven.	" "
1046	Chittenden's Potato Fertilizer.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	John S. Kirkham, Newington.
1045	Chittenden's Tobacco Fertilizer.	" " "	"	" " "
882	Tobacco Fertilizer, Conn. Brand.	Mapes' F. & P. G. Co., New York.	David Beers, Danbury.	Station Agent.
1003	Stockbridge Seeding-Down Manure.	Bowker Fert. Co., Boston, Mass.	J. A. Paine, Danielsonville.	" "
926	Matchless Tobacco Manure.	Read & Co., 34 Beaver St., N. Y.	A. C. Sternburg, Hartford.	" "
959	Potato Fertilizer.	Lister Bros., Newark, N. J.	R. B. Bradley & Co., N. Haven	" "
1044	Potato Manure.	Mapes' F. & P. G. Co., New York.	Mapes' Branch, Hartford.	John S. Kirkham, Newington.
906	Corn Manure.	H. J. Baker & Bro., "	Tolles & McEwen, Naugatuck.	Station Agent.
905	Potato Manure.	" " "	"	" "
913	Chittenden's Root Fertilizer.	Nat'l Fertilizer Co., Bridgeport.	Manufacturer.	" "
914	Chittenden's Grain Fertilizer.	" " "	"	" "
979	Stockbridge Grain Manure.	Bowker Fert. Co., N. Y. & Boston.	E. A. Watrous, Meriden.	" "
976	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., New York.	J. A. Paine, Danielsonville.	" "
973	Grass and Grain Spring Top Dressing.	Mapes' F. & P. G. Co., "	R. B. Bradley & Co., N. Haven.	" "
902	Stockbridge Manure for Corn.	Bowker Fertilizer Co., "	Apothecaries' Hall, Waterbury.	" "
895	Potato, Hop and Tobacco Phosphate.	Buffalo Fert. and Chemical Works.	Ruggles & Clark, Shelton.	" "
899	Stockbridge Grass Top Dressing and Forage Crop Manure.	Bowker Fertilizer Co., New York.	Apothecaries' Hall, Waterbury.	" "
903	Stockbridge Manure for Potatoes and Vegetables.	" " "	" "	" "
1000	Bowker's Lawn Dressing.	Bowker Fert. Co., Boston & N. Y.	E. A. Watrous, Meriden.	" "
989	English Lawn Fertilizer.	Wm. L. Bradley, Boston, Mass.	J. L. Butler, Torrington.	" "

SPECIAL FERTILIZERS—*Continued.*

Station. No.	Name.	Nitrogen of Nitrates.	Nitrog. of Ammonia Salts.	Nitrog. of Organic Matters.	Phosphoric Acid.			Potash.	Chlorine.	Estimated value per ton.	Cost per ton.	Cost exceeds Valuation
					Soluble	Reverted.*	Insoluble.					
972	Mapes' Tobacco Manure (for use with stems)	1.20	2.90	1.21	7.52	2.08	1.31	4.35	1.02	$52.24	$54.00	$ 1.76
965	Baker's Tobacco Manure	.10	4.15	.60	3.41	1.52	.39	9.03	.77	47.22	50.00	2.78
1043	Chittenden's Fertilizer for Corn and other Grain,	....	3.25	1.39	7.71	.91	.60	5.59	4.14	47.18	50.00	2.82
992	Baker's Grass Manure	....	4.30	.57	4.33	.96	1.22	8.19	8.04	44.47	47.50	3.03
975	Mapes' Potato Manure	.45	1.58	2.52	5.44	3.44	1.84	6.39	4.06	47.27	51.00	3.73
1046	Chittenden's Potato Fertilizer	....	3.14	1.00	7.69	.59	.62	5.07	.67	46.15	50.00	3.85
1045	Chittenden's Tobacco Fertilizer	....	3.31	.89	7.27	.97	.60	4.98	.71	46.02	50.00	3.98
882	Mapes' Tobacco Manure, Conn. Brand	2.98	1.86	.57	4.88	2.76	1.20	6.70	1.02	49.45	54.00	4.55
1003	Stockbridge Seeding-Down Manure	.36	....	3.01	6.45	1.01	3.46	5.88	4.83	40.25	45.00	4.75
926	Read & Co's Matchless Tobacco Manure	2.96	1.86	.32	5.66	1.17	1.24	4.18	1.75	43.36	50.00	6.64
959	Lister's Potato Fertilizer	....	.79	3.00	7.30	.83	.74	8.43	7.88	43.36	50.00	6.64
1044	Mapes' Potato Manure	.70	2.14	1.06	5.90	3.19	4.25	6.72	3.75	44.25	51.00	6.75
906	Baker's Corn Manure	....	3.38	.77	6.10	.40	.78	7.91	9.79	42.84	50.00	7.16
905	Baker's Special Potato Manure	....	2.59	.67	6.87	.67	.43	9.76	7.75	41.55	50.00	8.45
913	Chittenden's Root Fertilizer	.09	....	3.74	6.33	1.07	1.27	6.49	5.79	40.24	50.00	9.76
914	Chittenden's Complete Manure for Grain	.11	....	3.73	7.02	.86	1.09	5.15	4.86	40.11	50.00	9.89
979	Stockbridge Grain Manure	.48	.13	2.78	6.43	.99	3.39	5.31	5.10	39.70	†50.00	10.30
976	Stockbridge Forage Crop Manure	.21	.17	2.91	6.48	.77	3.61	4.06	2.08	89.11	50.00	10.89
973	Mapes' Grass and Grain Spring Top Dressing	1.47	.66	1.98	4.32	2.77	2.67	5.98	4.97	40.83	52.00	11.17
902	Stockbridge Corn Manure	....	....	3.83	6.63	.49	2.57	2.79	3.93	38.44	50.00	11.56
895	Buffalo Fert. & Chem. Works, Pot., Hop & Tob. Phos.	....	....	2.11	6.74	.77	2.08	4.74	4.32	32.30	45.00	12.70
899	Stockbridge Grass Top Dressing & Forage Crop Man.,	1.86	....	2.18	5.85	.55	1.49	4.05	3.72	36.45	50.00	13.55
903	Stockbridge Potato and Vegetable Manure	....	....	2.94	5.86	.79	1.83	6.10	4.05	35.45	50.00	14.55
1000	Bowker's Lawn Dressing	1.65	.21	2.06	6.10	.53	4.18	4.11	3.50	39.95	‡	....
989	Bradley's English Lawn Fertilizer	4.30	....	.11	5.78	1.14	0.97	3.42	3.80	36.32	....	....

* See page 23.

† Reckoned from cost per bag of 200 lbs.

‡ $3.00 per bag of 100 lbs.

SPECIAL FERTILIZERS OR "FORMULAS."

Thirty-one samples of this class of nitrogenous superphosphates have been analyzed during the year; a part of them for private parties. The analyses and valuations of those which have general interest are given on pages 44 and 45. Numbers **989** and **1000** are Lawn Fertilizers. The demand for them is relatively small and they are usually sold in lots of 100 to 200 lbs. Ton prices are not given.

Leaving out of account these lawn fertilizers, the average cost of 23 special fertilizers has been $49.98, the average estimated value $42.53 and the difference between cost and valuation $7.45.

For the last four years the average cost and the difference between cost and valuation have been as follows:

	1880.	1881.	1882.	1883.
Cost,	48.00	48.04	50.22	49.98
Difference between cost and valuation,	3.35	4.93	3.29	7.45

It will be noticed that the average difference between the cost and valuation of the special fertilizers is about one dollar per ton more than what it is in the case of the ammoniated superphosphates: that is, the fertilizing ingredients have been cheaper the past year in the latter than in the former goods.

On page 47 is a table compiled from all the analyses of the special manures there named, which have been made in this Station and in the New Jersey Station since 1878. It shows the average composition of each brand as well as the fluctuations in the composition of each. It also shows that there is no uniform and striking difference between the composition of fertilizers which are claimed to be specially adapted to the demands of one particular crop and the composition of those made for another crop. The term "special" is meaningless and there is no apparent reason for calling one of the samples an Onion manure rather than a corn or potato manure, for it would be impossible for any one to decide from its composition either what crop it was best suited for, or for what crop its manufacturer designed it. The special manures are to be regarded simply as superphosphates of higher grade than others. Their cost is greater, their estimated value is higher, and pound for pound they may fairly be expected to produce a larger yield than goods of lower grade.

CORN MANURE.

	No. of Analyses.	Nitrogen.			Phos. Acid.*			Potash.		
		Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
H. J. Baker's	3	4.5	5.0	4.2	5.6	5.8	5.4	8.0	9.5	8.0
Forrester's	6	4.9	5.5	3.9	6.6	8.0	5.3	9.8	14.6	6.6
Mapes'	8	3.7	4.0	3.4	9.4	11.7	5.4	7.0	11.2	4.6
Stockbridge's	7	4.8	6.2	3.8	6.1	7.4	3.8	6.0	7.0	3.9
Williams, Clark & Co's	1	5.2			5.2			6.0		

POTATO MANURE.

H. J. Baker's	4	4.7	7.4	3.5	5.4	6.3	4.9	10.3	12.9	9.1
Forrester's	7	4.5	5.7	3.4	6.0	7.6	5.3	10.2	11.4	9.0
Lister's	1	4.1			7.2			9.0		
Mapes'	5	3.7	3.9	3.4	8.0	10.3	4.6	8.0	14.8	5.0
Stockbridge's	7	3.3	3.5	2.9	7.0	7.6	6.4	6.8	10.2	4.9
Williams, Clark & Co's	3	2.9	3.3	2.5	6.2	7.3	5.4	10.7	11.9	8.6

TOBACCO MANURE.

H. J. Baker's	2	4.6	4.7	4.4	3.9	5.2	2.7	10.3	12.0	8.6
Forrester's	1	5.5			3.9			9.7		
Mapes'	4	5.0	5.9	3.6	7.1	7.8	5.6	6.3	9.0	4.4
Stockbridge's	2	5.9	6.1	5.7	3.8	6.1	1.4	6.5	7.4	5.6

ONION MANURE.

H. J. Baker's	1	5.0			6.2			9.6		
Forrester's	5	6.2	7.4	5.1	5.1	6.2	4.5	6.7	7.4	5.7
Mapes'	1	5.7			6.2			7.5		
Stockbridge's	2	3.5	3.9	3.1	5.9	6.4	5.3	8.1	8.3	7.9

BONE MANURES.

Method of Valuation.

For the benefit of those who have not the previous reports of the Station at hand, a detailed account of the method employed for the valuation of bone manures is here given, being in large part reproduced from former Reports.

Experience has led us to distinguish, for the purpose of valuation, five grades of ground bone, the proportions of which are found by a mechanical analysis, *i. e.*, by passing a weighed sample of the bone through a system of four sieves. These five grades have the dimensions, and during 1883, have had the trade-values below specified, viz:

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* Soluble and reverted.

Grade.	Dimensions.	1888. Estimated value per pound. Nitrogen.	1888. Estimated value per pound. Phos. Acid.
Fine,	smaller than one $\frac{1}{50}$ inch,	17 cts.	6 cts.
Fine medium,	between $\frac{1}{50}$ and $\frac{1}{25}$ inch,	15 "	5½ "
Medium,	" $\frac{1}{25}$ and $\frac{1}{12}$ inch,	14 "	5 "
Coarse medium,	" $\frac{1}{12}$ and $\frac{1}{6}$ inch,	13 "	4½ "
Coarse,	larger than $\frac{1}{6}$ inch,	11 "	4 "

The chemical and mechanical analysis of a sample of ground bone being before us, we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone.

To illustrate, Rogers and Hubbard's Raw Knuckle Bone, A, Extra fine, No. **860**, contains 3.92 per cent. of nitrogen or 78.4 lbs. per ton, and 23.61 per cent. of phosphoric acid or 472.2 lbs. per ton. The mechanical analysis showed:

Fine,	35 per cent.
Fine medium,	33
Medium,	24
Coarse medium,	8
Coarse,	0
	100

The calculations are as follows:

$$\begin{aligned}
78.4 \times 35 \div 100 \times 17 &= \$4.67 \\
78.4 \times 33 \div 100 \times 15 &= 3.88 \\
78.4 \times 24 \div 100 \times 14 &= 2.63 \\
78.4 \times 8 \div 100 \times 13 &= .82
\end{aligned}$$

Estimated value of nitrogen, $12.00

$$\begin{aligned}
472.2 \times 35 \div 100 \times 6 &= \$9.92 \\
472.2 \times 33 \div 100 \times 5\tfrac{1}{2} &= 8.57 \\
472.2 \times 24 \div 100 \times 5 &= 5.67 \\
472.2 \times 8 \div 100 \times 4\tfrac{1}{2} &= 1.70
\end{aligned}$$

Estimated value of phosphoric acid, $25.86

$37.86

The result agrees with the cost price ($37.50) within 36 cents.

When the sample of bone contains foreign matters introduced as preservatives, dryers or adulterants, such as salt, salt-cake, niter-cake, ground oyster-shells, spent lime, plaster, or soil, these must be taken account of in the mechanical analysis, especially since they would be likely, on sifting, to pass chiefly or entirely into the finer grades. In such cases, the several grades as obtained by sifting must be separately examined, and the amounts of foreign matter which they contain must be suitably taken into the account if an *exact* valuation is desired.

A single examination of this kind has been made in the case of No. 884 Lister's Celebrated Ground Bone, which contains a considerable quantity of salt cake and some salt. A second mechanical analysis was made, agreeing essentially with the one given on page 53, and nitrogen and phosphoric acid were determined in each of the grades. The results were as follows reckoned on 100 lbs. of bone.

Grade.	Pounds per 100.	Per cent. of nitrogen.	Pounds of nitrogen. Per 100 lbs. bone.	Per cent. of phos. acid.	Pounds of phos. acid. Per 100 lbs. bone.
Fine, ...	45	1.54	.69	9.27	4.19
Fine medium, ..	15	2.39	.41	13.82	2.07
Medium, ...	17	2.92	.50	14.39	2.44
Coarse medium,	18	2.92	.53	17.46	3.15
Coarse, ...	5	3.35	.17	19.94	1.00
	100		2.30		12.85

The total nitrogen (2.30 pounds per hundred) and the total phosphoric acid (12.85 pounds per hundred) agree reasonably well with the amounts found by the usual method of analysis, viz: nitrogen, 2.41 ; phosphoric acid, 12.55. It will be seen that the percentage amount of nitrogen and phosphoric acid in the coarsest portion is more than twice that in the finest portion, which shows that the most of the foreign material—salt, salt-cake, etc.—sifts out with the finer part of the bone. Now, in computing the estimated value, nitrogen and phosphoric acid have a valuation which is higher in the finer grades (see page 24), and it is assumed that the percentage composition of all the grades is alike. If, as in this case, the finer grades have a lower percentage of nitrogen and phosphoric acid than the coarser, the valuation will be too high. To see whether the error is a considerable one, the valuation has been recalculated from the amounts of nitrogen and phosphoric acid actually found in each grade, and is $20.06 per ton, while calculated in the usual way it is $20.78. The difference, 72 cents, is inconsiderable; less than might be expected between two samples of the same brand.

Even where the bone is unmixed with a dryer or adulterant, it may often happen that the proportions of nitrogen and phosphoric acid are not the same in the finer and coarser portions.

There is, however, a limit beyond which it is useless to attempt to refine the processes of valuation. When they become too complicated or costly, they defeat the object which they should serve. It is sufficient that the errors of valuation are no greater than those which arise from unavoidable variations in different portions of the same lot of fertilizer, or in different lots of the same brand. A difference of two or three dollars between cost and estimated value cannot ordinarily demonstrate that either is out of the way.

BONE MANURES.

Analyses.

The analyses and valuations of 23 samples will be found on pages 52 and 53.

986 was quite wet, which explains its low percentage of nitrogen and phosphoric acid. It would be excellent material for composting or immediate application to land, but could not be transported far nor stored without loss.

939 is a waste product from the glue factory. A large part of the nitrogenous animal matter has been extracted, leaving it poor in nitrogen and correspondingly rich in phosphoric acid. It retails in New York at $30.00 per ton, and freight to Southport is $1.00; but farmers, by making up an order for a lot of 10 tons, got it for $29.50 on the dock at Southport.

985 is very coarse, 90 per cent. of it being held on a sieve with one-sixth inch meshes. It is doubtful if it deserves as high a valuation as has been given it.

1016 is manufactured by the Adamson process. The water and grease are nearly or entirely removed by the vapor of benzine, leaving the bone dry, brittle and porous.

The average cost per ton of ground bone in the samples examined this year is $35.88; the average estimated value, $32.95; and the difference between cost and valuation, $2.93.

"Rotted Bone."

871. From stock of James H. Baker, 104 Clymer street, Brooklyn. Sent by E. Hoyt, New Canaan.

Analysis and Valuation.

Water,	29.04
Sand and insoluble,	22.02
Nitrogen,	2.65
Phosphoric acid,	1.59
Estimated value per ton,	$14.10
Cost in New York,	$16.00

On the Solubility of Bone in Ammonium Citrate.

It is known that a very small part of the phosphoric acid of bones may be extracted from them with cold water, while a large amount is taken up by solution of ammonium citrate,* which is used to remove the so-called "reverted" phosphoric acid from superphosphates. Seventeen samples of bone have been extracted with ammonium citrate solution in order to learn their average solubility in it, and also to find out whether the phosphoric acid of bone which has been mixed with salt or salt-cake is more soluble than that of pure bone. Two grams of the bone, in the condition in which it came to the Station, were digested with 100 c. c. of neutral Am. Cit. solution (Sp. gr., 1.09) for half an hour at 40° C., shaken every five minutes, and then filtered at once. The samples are arranged according to their fineness, and the results are given on page 54.

An examination of the figures shows that on the average 18.9 per cent. of the phosphoric acid in the pure bones was soluble, 81.1 per cent. insoluble in Am. Cit. The solubility was greater in the finer bones *on the average.* In those which had no particles larger than one-twelth inch, the average solubility was 24.1 per cent. Where all the particles were smaller than one-sixth inch it was 19.1 per cent.; while in the coarser samples it was 10.2 per cent. The solubility is doubtless affected by other things than the fineness. The amount of grease present, the character of the bone, whether hard (from factories where bone is worked) or soft, and the method of grinding, all have an effect in hindering or helping the solvent action of water or ammonium citrate.

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* This is the substance formed by saturating or neutralizing the acid of lemons by ammonia.

BONE MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
1016	Swift Sure Bone Meal.	M. L. Shoemaker & Co., Phila.	F. Ellsworth, Hartford.	F. Ellsworth, Hartford.
939	Peter Cooper's No. 2 Bone.	Peter Cooper's Glue Factory.	Manufacturer.	E. S. Spring, Green's Farms.
892	Ground Bone.	F. C. Slade, Oakville.	"	F. C. Slade, Oakville.
883	Wilson's Pure Bone Flour.	Wilson, Norwalk.	Raymond Bros., South Norwalk.	Station Agent.
908	Ground Bone.	E. Smith, South Canterbury.	Manufacturer.	Manufacturer.
986	Damp Bone Sawings.	Rogers & Hubbard Co., Middletown.	"	"
860	Raw Knuckle Bone, "A" Extra Fine.	Rogers & Hubbard Co., Middletown.	"	"
950	Ground Bone.	M. McNamara, Trumbull.	"	J. H. Jennings, Green's Farms.
981	Bosworth Bros. Ground bone.	Bosworth Bros., Putnam.	"	Manufacturer.
1009	Bone, Grade "A" Extra Fine.	Rogers & Hubbard Co., Middletown.	Southmayd & Gardiner, Middletown.	Station Agent.
859	Raw Knuckle Bone, "Meal."	Rogers & Hubbard Co., Middletown.	Manufacturer.	Manufacturer.
1050	Ground Bone.	P. W. Bennett, Rock Fall.	"	"
1004	Pure Ground Raw Knuckle Bone, Grade Meal.	Rogers & Hubbard Co., Middletown.	Southmayd & Gardiner, Middletown.	Station Agent.
1012	Darling's Fine Ground Bone.	L. B. Darling & Co., Pautucket, R. I.	J. P. Barstow & Co., Norwich.	" "
985	Ground Bone.	W. P. Lawrence, Millbrook.	Manufacturer.	Manufacturer.
1007	Miller's Bone.	G. W. Miller, Middlefield.	C. E. Chapman, Westbrook.	Station Agent.
995	Bowker's Fine Ground Bone.	Bowker Fertilizer Co., Boston and New York.	E. A. Watrous, Meriden.	" "
970	Harris & Son's Ground Bone.	G. H. Harris & Son, Eagleville.	Manufacturer.	" "
990	Thompson & Edwards' Pure Fine Ground Bone.	Thompson & Edwards, Chicago.	J. S. Wells, Hebron.	" "
958	Peck Bros.' Pure Ground Bone.	Peck Bros., Northfield.	G. H. Alford & Co., Winsted.	" "
884	Lister's Celebrated Ground Bone.	Lister Bros., Newark, N. J.	Raymond Bros., South Norwalk.	" "
951	Ground Bone.	Preston Fertilizer Co., Greenpoint.	J. B. Merrow & Sons, Merrow.	" "
996	Crescent Bone.	Lister Bros., Newark, N. J.	J. P. Barstow & Co., Norwich.	" "

BONE MANURES—ANALYSES AND VALUATIONS.

Station No.	Name.	Nitrogen.	Phos. Acid.	Finer than				Coarser than 1/8 inch.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
				1/50 inch.	1/25 inch.	1/12 inch.	1/8 inch.				
1016	Shoemaker's Swift Sure Bone Meal	6.61	19.84	60	35	5	0	0	$52.58	$45.00	$7.58
989	Peter Cooper's No. 2 Bone	1.67	28.99	35	18	27	20	0	35.99	28.50	7.49
892	Slade's Ground Bone	3.97	23.52	17	24	27	23	9	35.25	32.00	3.25
883	Wilson's Pure Bone Flour	3.92	23.61	19	29	52	....	....	36.85	35.00	1.85
908	Smith's Ground Bone	4.38	20.86	24	33	26	17	....	35.27	34.00	1.27
986	Rogers & Hubbard Co's Damp Bone Sawings	2.00	15.89	95	5	....	....	....	25.73	25.00	.73
860	" " " Raw Knuckle Bone, "A" Extra Fine	3.92	23.61	35	33	24	8	....	37.65	37.50	.15
											Cost exceeds Valuation.
950	McNamara's Ground Bone	4.03	20.32	19	15	24	32	10	31.70	31.75	.05
981	Bosworth Bros.' Ground Bone	3.68	22.17	32	38	25	4	1	35.54	36.00	.46
1009	Rogers & Hubbard Co's Bone, Grade A Extra Fine	3.84	24.48	19	16	52	13	....	36.69	37.50	.81
859	" " " Raw Knuckle Bone, "Meal"	3.87	23.36	50	43	7	....	....	39.04	40.00	.96
1050	Bennett's Ground Bone	3.09	24.32	16	18	24	22	20	32.58	34.00	1.42
1004	Rogers & Hubbard Co's Pure Gr'd Raw Kn'le Bone, Meal	3.97	23.80	35	33	32	....	....	38.48	40.00	1.52
1012	Darling's Fine Ground Bone	3.28	23.77	72	21	7	0	0	38.43	42.00	3.57
985	Lawrence's Ground Bone	3,95	22.55	0	1	3	6	90	27.28	32.00	4.72
1007	Miller's Bone	3.95	24.47	15	21	49	15	....	36.80	42.00	5.20
995	Bowker's Fine Ground Bone	3.27	22.82	49	19	21	11	....	35.40	42.00	6.60
970	Harris & Son's Ground Bone	3.82	19.17	....	2	17	39	42	26.30	33.00	6.70
990	Thompson & Edwards' Pure Fine Ground Bone	1.25	22.40	66	20	10	4	....	29.76	38.00	8.24
953	Peck Bros.' Pure Ground Bone	3.60	20.22	9	18	31	28	14	29.69	40.00	10.31
884	Lister Bros.' Celebrated Ground Bone	2.41	12.55	47	17	16	20	....	21.12	33.00	11.88
951	Preston's Ground Bone	3.56	10.65	38	17	16	13	16	21.68	35.00	13.32
996	Lister Bros.' Crescent Bone	1.76	11.57	50	15	15	15	5	18.01	32.00	13.99

The three samples, **996**, **884** and **951**, all have an acid reaction, doubtless due to bisulphate of soda in the salt-cake which has been added to them. It was to be expected, therefore, that the phosphoric acid in them would be more soluble than in pure bone; 45.6 per cent. of their phosphoric acid on the average is soluble, and 54.4 per cent. insoluble. One of them, **884**, furnishes more soluble phosphoric acid, pound for pound, than pure bone, but less than half as much insoluble phosphoric acid and less than two-thirds as much nitrogen.

SOLUBILITY OF BONE IN AMMONIUM CITRATE.

Station No.	Mechanical Analysis.					Soluble in Am. Cit.	Insoluble in Am. Cit.
	Fine $\frac{1}{50}$ in.	Fine medium $\frac{1}{25}$ in.	Medium $\frac{1}{12}$ in.	Coarse medium $\frac{1}{8}$ in.	Coarse.		
859	50	43	7	0	0	6.60	16.76
1012	72	21	7	0	0	6.75	17.02
990	66	20	10	4	0	3.73	18.80
981	32	38	25	4	1	3.12	19.07
1004	35	33	32	0	0	4.41	19.39
860	35	33	24	8	0	5.00	18.61
908	24	33	26	17	0	6.46	14.40
939	35	18	27	20	0	6.72	22.27
883	19	29	52	0	0	4.88	18.73
1007	15	21	49	15	0	2.90	21.57
1009	19	16	52	13	0	2.72	21.76
950	19	15	24	32	10	1.25	19.07
953	9	18	31	28	14	2.43	17.79
970	0	2	17	39	42	1.69	17.48
996	50	15	15	15	5	3.52	8.00
84	47	17	16	20	0	7.75	4.80
51	38	17	16	13	16	4.73	5.92

DRY GROUND FISH.

[See next page.]

A part of the samples analyzed contained acidulated fish scrap making it desirable to determine the amount of soluble and reverted phosphoric acid. To make a fair comparison of the several brands, all have been treated in the same way.

865. Chittenden's Dry Ground Fish was valued at $45.51 per ton in Bulletin No. 73 (p. 13). The higher valuation given to soluble and reverted phosphoric acid raises its valuation to $47.51 per ton.

FISH FERTILIZERS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
865	Chittenden's Fine Ground Fish.	National Fert. Co., Bridgeport.	Manufacturer.	Station Agent.
968	Dry Ground Fish.	Quinnipiac Fert. Co., N. London,	R. B. Bradley & Co., N. Haven.	" "
1020	Mapes' Dry Ground Fish.	Mapes' F. & P. G. Co., N. Y. City.	Manufacturer.	Wm. C. Newton, Durham.
1006	Geo. W. Miles' Dry Fish Guano.	Geo. W. Miles Co., Milford.	F. Ellsworth, Hartford.	Station Agent.
1014	Dry Ground Fish.	Quinnipiac Fert. Co., N. London.	Olds & Whipple, Hartford.	Olin Wheeler, Buckland.
978	Bowker's Dry Ground Fish.	Bowker Fert. Co., N. Y. & Boston.	Coburn & Gale, Hartford.	Station Agent.
963	Preston & Son's Dried and Ground Fish Guano.	Preston & Sons, Greenpoint, L. I.	Wilson & Burr, Middletown.	" "

FISH FERTILIZERS.

Station No.	Name.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	*Reverted Phos. Acid.	Insoluble Phos. Acid.	Estimated value per ton.	Cost per ton.	Valuati'n exceeds Cost.
865	Chittenden's Fine Ground Fish	....	8.35	1.21	1.96	2.75	$47.51	$45.00	$2.51
968	Quinnipiac Fertilizer Co's Dry Ground Fish	....	8.50	1.33	3.43	2.22	50.17	48.00	2.17
1020	Mapes' Dry Ground Fish	.15	6.99	.42	2.94	3.80	43.11	42.00	1.11
1006	Geo. W. Miles' Dry Fish Guano	....	7.75	1.27	3.02	2.54	46.32	46.00	.32
									Cost exceeds Valuat'n.
1014	Quinnipiac Fertilizer Co's Dry Ground Fish	....	7.66	.87	2.95	3.25	45.77	46.00	.23
978	Bowker Fertilizer Co's Dry Ground Fish	.40	5.23	1.03	4.65	2.65	39.03	45.00	5.97
963	Preston & Son's Dried and Ground Fish Guano	1.04	1.90	2.96	1.72	.84	24.42	35.00	10.58

* See page 23.

963. Preston Sons' Dried and Ground Fish Guano contains rather less phosphoric acid and very much less nitrogen than is usually found in dried fish scraps.

The average cost of the samples analyzed (excepting **963**) is $45.33 per ton, the average estimated value $45.32.

NITRATE OF SODA.

928. From stock of Mapes' Conn. Valley Branch, Hartford, stated not to be on sale in Connecticut.

941. Quinnipiac Fertilizer Co., New London. From stock of Wilson & Burr, Middletown. Sampled by J. M. Hubbard, Middletown.

ANALYSES.	928	941
Nitrogen,	15.48	15.46
Equivalent nitrate of Soda,	94.00	93.90
Cost,	$70.00	67.00
Nitrogen costs per 100 lbs.,	$22.61	21.67

SULPHATE OF AMMONIA.

929. Sulphate of Ammonia from stock of Mapes' Connecticut Valley Branch, Hartford. Stated not to be on sale in Conn.

1018. Sulphate of Ammonia from Mapes F. & P. G. Co., New York. Sampled and sent by Michael Donovan, South Windsor.

ANALYSES.	929	1018
Nitrogen,	20.74	20.34
Equivalent sulphate of ammonia,	97.78	95.70
Cost per 100 lbs.,	$4.75	4.75
Nitrogen costs per 100 lbs.,	$22.90	$23.35

Both samples were of good quality. **1018** had a slight bluish tinge, due probably to the presence of a trace of cyanogen compounds insoluble in water. It contained no soluble cyanogen compounds [cyanides or sulphocyanides.] The soluble cyanides are poisonous to vegetation if applied in considerable quantity, but it is likely that their poisonous quality has been somewhat over-estimated. Maercker* found that one per cent. of ammonium sulphocyanide in a superphosphate did no damage, and 89 lbs. of it to the acre did not injure oats. Schumann on the other hand found that 178 lbs. per acre did serious injury to grass land.

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* Centralblatt Ag. Chem., 1883, p. 497

MEAT AND PLASTER.

919. Made by the Quinnipiac Co., of Wallingford. The sample consists of about ⅓ meat and ⅔ plaster. It contains 20.28 per cent. of water, 1.9 per cent. of nitrogen and about 65 per cent. of plaster. Allowing 18 cents per lb. for the nitrogen and 40 cents per 100 lb. for the plaster, its estimated value is $12.04 per ton.

COTTON SEED AND CASTOR POMACE.

Analyses and Valuations.

880. Castor Pomace, manufactured by Robert B. Brown Oil Co., St. Louis, Mo. Sampled and sent by Geo. D. Martinez, General Agent.

935. Castor Pomace, manufactured by the Collier White Lead and Oil Co., St. Louis, Mo. Sampled from stock of Olds & Whipple, Hartford, by Station Agent.

966. Castor Pomace manufactured by H. J. Baker & Bro. Sampled from stock of A. W. Allen, Jr., Thompsonville, by Station Agent.

1002. I. X. L. Pomace, manufactured by Robt. B. Brown Oil Co., St. Louis, Mo. Sampled from stock of F. Ellsworth, by Station Agent.

876. Cotton Seed Meal, from the stock of G. C. Richards & Co., Unionville. Sampled and sent by Wm. Smith, Plainville.

1053. Cotton Seed Meal, from stock of E. Ellsworth, Hartford. Sampled and sent by H. S. Frye, Poquonock.

1054. Cotton Seed Meal, from stock of E. Ellsworth, Hartford. Sampled and sent by A. E. Holcomb, Poquonock.

ANALYSES AND VALUATIONS.

Station No.	Nitrogen.	Phosphoric Acid.	Potash.	Estimated value per ton.	Cost per ton.
880	5.64	1.87	.93		$23.00
935	5.76	2.07	1.03	$24.10	23.00
1002	5.50	2.10	1.06	23.22	23.00
966	4.58	1.59	1.07	19.31	20.00
876	6.95	2.51	1.91	29.65	31.00
1053	7.39	2.84	1.24	31.06	30.00
1054	7.25	3.07	1.37	30.94	30.00

POTASH SALTS.

Analyses and Valuations.

[See page 60.]

Four of the samples analyzed are high grade muriates, supplying potash at 3.9 to 4.4 cents per pound, and seven are kainit in which the potash costs from 5.8 to 7.4 cents per pound, or 6½ cents on the average.

During last spring kainit sold in N. Y. in ton lots at point of shipment for cash, at from $10 to $12.60. This included bags and cartage. (Bulletin XXVII, N. J. Experiment Station.) It was therefore possible for farmers in the central and western parts of the State at least, to get it for considerably less than $15 to $18, the price charged by Connecticut dealers.

Below are given complete analyses of the three potash fertilizers which are most used here at the present time. The analyses of Muriate of Potash and Double Sulphate of Potash and Magnesia were made by Dr. Goessmann, and published in Bulletin No. 3, of the Mass. Experiment Station, pp. 5 and 6. The kainit is No. **937**, analyzed at this Station.

ANALYSES OF POTASH SALTS.

	Muriate.	Potash and magnesia sulphate.	Kainit.
Moisture at 100°,	2.88	4.90	15.30
Potash,	50.35	24.94	12.23
Soda,	8.33	2.09	16.05
Lime,		1.15	.43
Magnesia,	.40	11.30	11.16
Oxide of iron and alumina,			.25
Sulphuric acid,	.18	46.99	22.26
Chlorine,			27.98
Insoluble matter,	.60	.54	.26
Other matters not specified in the analysis,	37.26*	8.09	
			105.92
Deduct oxygen equivalent to chlorine,			6.31
	100.00	100.00	99.61

From these analyses it appears that the high grade muriate consists of about 80 per cent. of potassium chloride (muriate), 16 per cent. of sodium chloride (salt), and 4 per cent. of water and various other matters. The double sulphate of potash and magnesia contains 46 to 47 per cent. of potassium sulphate, 33 to 34 per cent. of magnesium sulphate, 5 per cent. of water and 15 per cent. of sulphates of soda and lime, and other matters. Kainit contains about 85 per cent. of sulphates and chlorides of potassium, sodium and magnesium and 15 per cent. water.

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* Mostly Chlorine.

SALTPETER REFUSE.

853. From stock of S. J. Archer, 194 Duane street, New York. Sampled and sent by S. S. Green, New Milford, Ct.

ANALYSIS.

*Nitric acid (N_2O_5),	4.44
Chlorine,	54.41
Potash,	4.27
Soda,	48.21
Insoluble matters,	.88
	112.21
Deduct oxygen equivalent to chlorine,	12.26
	99.95

* Nitrogen 1.15.

The compounds probably existing in this refuse are:

Potassium nitrate (saltpeter),	8.31
Potassium chloride,	.61
Sodium chloride (salt),	90.20
Insoluble matter,	.88
	100.00

It is a mixture of nine parts of salt and less than one part of saltpeter and is probably a waste product from some manufacturing process. Its cost is $10 per ton on cars in New York. Allowing 4½ cents per lb. for the potash and 20 cents per pound for the nitrogen, its estimated value would be $8.23. It could be safely used only in moderate quantity since for every pound of saltpeter applied, 10 pounds of salt would also be applied. [If the price were lower, those who *salt* their meadows would find this an excellent material for the purpose.]

POTASH SALTS.

Station No.	Name.	Importer.	Dealer.	Sampled and Sent by
931	Muriate of Potash.	H. J. Baker & Bros., New York.	Southmayd & Gardiner, Middletown.	Station Agent.
930	" " 80 per cent.		Mapes' Conn. Valley Branch, Hartford.	" "
943	" "	Quinnipiac Fertilizer Co., New London.	Wilson & Burr, Middletown.	J. M. Hubbard, Middletown.
932	" "	H. J. Baker & Bros., New York.	S. J. Hall, Meriden.	Station Agent.
933	Acorn Brand German Potash Salts.	Williams, Clark & Co., N. Y.	F. Ellsworth, Hartford.	" "
938	Kainit.	H. J. Baker & Bros., New York.	H. K. Brainard, Thompsonville.	J. Thompson, Broad Brook.
940	"	Bowker Fertilizer Co.	" " "	" "
937	" (Leopoldshall).		Mapes' Branch, Hartford.	Station Agent.
917	"		Navassa Phosphate Co., N. Y.	J. M. Millbank, Greenfield Hill.
934	"	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
936	"		Usher & Tinker, Plainville.	" "

Analyses.

	931	930	943	932	933	938	940	937	917	934	936
Potash	54.26	57.82	52.29	51.55	12.59	12.97	11.80	12.23	12.24	12.45	11.52
Equivalent Muriate of Potash	85.94	91.58	82.82	81.65	----	----	----	----	----	----	----
" Sulphate of Potash	----	----	----	----	23.30	23.98	21.80	22.62	22.63	23.09	21.30
Cost	$42.00	45.00	42.00	45.00	15.00	15.00	15.00	18.00	16.00	15.00	17.00
Potash costs per 100 lbs.	$ 3.87	3.89	4.01	4.36	5.90	5.78	6.36	7.36	6.54	6.02	7.38

PLASTER.

894. Plaster; ground by Knickerbocker Plaster Mills, New York; sold by Ruggles & Clark, Shelton, Ct. Sampled by Station Agent.

949. Plaster.

1028. Double Ground Land Plaster. J. B. King & Co., New York. From stock of R. B. Bradley & Co., New Haven.

849. Nova Scotia Land Plaster, ground by G. W. Miller, Middlefield.

858. Nova Scotia Land Plaster, ground by V. C. & C. V. King, New York City.

850. Onondaga Land Plaster, ground by E. B. Alvord & Co., Jamesville, N. Y.

1029. A. A. Union Ground Plaster, Whitmore Bros., Boston. From stock of J. A. Paine, Danielsonville.

1030. Nova Scotia Land Plaster, Newburgh Plaster Works, N. Y. From stock of Wilcox & Judd, Bristol.

1031. Pure Ground Nova Scotia Plaster, John Hurd, Bridgeport. From stock of G. H. Alvord & Co., Winsted.

949, 849, 858, and **850** were sent by Harvey Elliott, North Guilford, the other samples were taken by Station agents.

It will be noticed that **894** and **949** consist of burned and unburned plaster in approximately equal proportions.

Onondaga Plaster, **850,** contains, as usual, over 20 per cent. of carbonates. The Nova Scotia variety is a purer sulphate of lime. **1030** has a larger percentage of carbonate than is commonly present in Nova Scotia plaster.

A correspondent inquires:

"1st. What is the comparative value of Cayuga and Nova Scotia plaster as fertilizers?

"2d. Are the carbonates found in Cayuga plaster of any value in agriculture, and if so, how much?"

It was replied in substance: Commercially considered, the plaster that gives us the most sulphate of lime for the money is the best, provided the pulverization is equal; agriculturally the same is true in general. Carbonate of lime sometimes, no doubt, may act well where sulphate of lime would be pronounced useless and in such a case the Cayuga plaster would be better than the Nova

Plaster-Analyses.

	894	949	1028	849	858	850	1029	1030	1031
Sulphuric acid	52.20	52.08	46.08	43.65	43.98	34.38	44.66	40.84	44.86
Water	8.57		19.30				19.85	18.47	20.02
Insoluble in acids	.98	.51	.54	1.88	2.67	4.64	2.56	.99	2.57
Lime		(36.61)							
Undetermined	1.71	.56	1.81	4.28	2.77	†21.44	1.43	†11.20	0.97
Hydrated sulphate of lime (gypsum)	40.94	48.88	92.21	93.84	94.56	73.92	96.01	87.81	96.46
Sulphate of lime (anhydrite or burned plaster)	56.37	50.05	5.44						
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pure gypsum equivalent to total sulphate of lime	112.23	111.97	99.07						
Cost per ton	$11.50	....	*$15.00	$8.00	$5.50	$6.00	$10.00	$8.00	$9.00

* Reckoned from price per bag of 200 lbs.

† Chiefly carbonate of lime.

Scotia. But carbonate of lime is much commoner and ought to be much cheaper than sulphate; so that there is entire propriety in insisting on the superiority of a pure over an impure article in any *general* statement or comparison. If a farmer ordering ground plaster should have ground limestone supplied him at $8 to $10 per ton he would feel abused even though the result on his crops were as good as it would have been had he got what he ordered. Carbonate may help the crops and at the same time outrage the moral sense.

LIMESTONE ROCK.

Four samples of this material have been analyzed at the request of Professor B. F. Koons of the Storrs Agricultural School.

Professor Koons has kindly communicated the following particulars with regard to them, as well as the analysis of a fifth sample made by Professor J. H. Washburn of the Storrs School.

ANALYSES OF LIMESTONES.

	Near Bolton Notch.		Lebanon.	N. W. of Norwich.	No. Stonington. Analysis by Prof. J. H. Washburn.
	944	**945**	**946**	**947**	
Insoluble in acids,	1.73	80.26	46.51	32.24	4.39
Oxide of iron and alumina,	1.50	5.71	4.78	7.56	2.57
Lime,	53.51	6.67	26.65	22.82	31.17
Magnesia,	.54	.98	.92	.60	17.80
Phosphoric acid,	.07	.09	.09	.15	
Carbonic acid and undetermined matter,	42.65	6.29	21.05	16.63	44.07
	100.00	100.00	100.00	100.00	100.00
Carbonate of lime,	95.56	11.91	47.59	40.75	55.66
Carbonate of magnesia,	1.13	2.06	1.93	1.26	37.38

"Nos. **944** and **945** are from a large layer occurring on the east side of the ridge through which the N. Y. and N. E. railroad cuts at Bolton Notch, about twelve miles east of Hartford.

"No. **945** was taken from the walls of the cut where the layer is about fifty feet thick and resembles the adjoining massive and schistose rocks so much that it was only by the aid of acid that the presence of lime was detected. At the center of this layer the effervescence was very decided with dilute hydrochloric acid, but this character was less marked as the top or bottom of the layer was approached. I am not certain as to just where in the fifty feet layer No. 945 was taken, although I think from near the middle.

" No. **944** comes from a series of old abandoned hydromica slate quarries on the east side of the ridge extending for half a mile or more south from the railroad cut. The quarries have exposed the limestone in considerable quantities, yet at no place could I find the whole thickness of the layer as it is in the cut at the railroad.

"The stone varies considerably in character, some of it resembling that exposed in the cut, and again in places thin layers of highly crystalline, almost pure white, limestone occur. No. **944** comes from one of these layers about three inches thick. Just to the north of the railroad there is a larger bluff of this limestone and the outcrop can be traced a mile or more to the north.

" No. **946** was taken from a line of boulders in the town of Lebanon. These may have been carried there from the outcrop near Willimantic, possibly from Bolton, yet the direction of the line would indicate that they came from neither of these localities, but from some place not yet discovered, between these, and to the north of where the boulders are found.

" No. **947** is from a very extensive bed about three miles to the northwest of the city of Norwich. This doubtless is the most extensive exposure of limestone in Eastern Connecticut, as the outcrop extends two and a half or three miles along the brow of a hill, and at an old "Gold Mine" a layer fifty feet thick is exposed. The rock is deceptive in appearance, looking much like gneiss and has a great deal of feldspar, intermingled also in large veins.

"Professor Forrest Shepherd showed me where some lime, burned in an indifferent way from this outcrop, and spread in a careless manner upon a grass field near the city had caused a yield of from four to six times as much grass as grew where the lime had not been placed.

" This limestone has easy transportation down hill to the railroad.

" The purest limestone of eastern Connecticut that occurs in abundance is found in very extensive beds on the line between Preston and North Stonington. The accompanying analysis by Prof. J. H. Washburn, of the Storrs Agricultural School, exhibits the chemical composition of a sample. (See Table of Analyses.) This limestone has a bluish tint, is said to cut like Italian marble, and is admired for its strength and durability. It is densely crystalline so as to exclude moisture, hence frost has but little effect upon it.

"Lime was burned here a great many years ago, and from Prof. Forrest Shepherd, with whom I visited the locality, I learn that the cement (made from this lime) having suffered eighty years' exposure, still remains firm.

"The limestone near Willimantic is underrated as to its extent in the account given of it in the Station Report for 1881, pp. 58, 59. I have made several visits to the locality, and find the beds much thicker than there reported. At one place there is a horizontal surface of fifty feet exposed, and the layers have a dip of twenty-two degrees, which would give us a bed of over eighteen feet in thickness instead of *three* feet as stated.

"The Norwich and North Stonington limestone beds are destined to become of great value to the agricultural interests of eastern Connecticut as a source of fertilizing material. The North Stonington deposits would also appear to have considerable value for architectural purposes.

Mansfield, Conn., Nov. 28th, 1883."

ROCK FROM A LEDGE IN NEW CANAAN.

With regard to this material, Edwin Hoyt, of New Canaan, wrote as follows:

"The stone came from a ledge on the land of one of our farmers, which he has had ground in the past, and finds it to make very green and luxuriant grass. * * * He says it grinds as easily as plaster, and thinks it better as a fertilizer."

The analysis is as follows:

	1027
Water at 100°,	2.15
Combined water,	9.60
Sand and undecomposed silicates,	16.19
Silica from decomposable silicates,	26.44
Oxide of iron and alumina,	8.65
Lime,	7.63
Magnesia,	24.35
Potash,	.32
Soda,	trace
Carbonic acid,	5.30
Phosphoric acid,	.04
	100.67

To Mr. Hoyt was written in substance as follows:

The excess (.67) over 100 per cent. is due to slight and unavoidable errors of analysis. The rock consists essentially of 16 per cent. of quartz and silicates which are not attacked by strong acids, 12 per cent. of carbonate of lime, and 72 per cent. of hydrous silicates of iron, alumina, lime and magnesia, with a little potash. Applied to land it would supply a considerable quantity of magnesia, probably in a form readily available to plants. It is not likely, however, that soils in your part of the State are at all deficient in magnesia, and its favorable effect on land is rather to be attributed to its furnishing lime; perhaps, also, to its mechanical action as an "amendment" and to the presence of the hydrous silicates, which have important uses in the soil, both as a source of plant food and in absorbing and retaining plant food which might otherwise pass into the subsoil out of the reach of vegetation.

QUICK LIME.

Two samples of quick lime were sent by R. E. Pinney, Suffield, with the inquiry, Which is the cheaper for agricultural use?

910. Barrel lime. Costs $13.00 in Suffield.

911. Paper mill lime. Costs $10.00 to $10.50 in Suffield.

ANALYSES.

	910	911
Insoluble in acid,	1.40	2.85
Carbonic acid,	.30	.25
Lime,	55.33	85.08
Combined water,	3.36	6.15
Magnesia,	36.37	5.67
Other matters by difference,	3.24	
	100.00	100.00

910 is probably made from Canaan limestone, which is a carbonate of lime and magnesia (dolomite). More than one-third of it is magnesia. **911** contains nearly 30 per cent. more lime than **910**. The former is therefore the better of the two at the same price.

WASTE LIME FROM PAPER WORKS.

854. From F. Whittlesey's paper mill, Windsor Locks. Sampled and sent by R. E. Pinney.

ANALYSIS.	
Insoluble in acid,	1.99
Oxide of iron and alumina,	.87
Lime,	45.08
Carbonic acid,	5.95
Combined water,	12.06
Water at 100°,	33.19
Undetermined,	.86
	100.00

It contains in round numbers 50 per cent. of slaked lime, 13½ per cent. of carbonate of lime, 33 per cent. of water, and 3½ per cent. of other matters. This sample had dried out somewhat before reaching the Station; the fresh material is a paste. Two and a half tons of it would not yield more slaked lime than one ton of paper mill lime **911.**

INFUSORIAL EARTH.

870. Sent by Ellis Bagley, Branford, as a "marl."

872. Sent by Joseph Sellers, Portland. Taken from the bed of a pond which dried up in the Summer. It forms a layer four to five feet deep under a bed of muck eighteen inches deep.

ANALYSES.	870	872
Silica and sand,	94.70	92.07
Loss on ignition (organic matter and water),	2.57	4.44
Oxide of iron and alumina,	2.18	3.49
Undetermined,	.55	
	100.00	100.00

These samples have no fertilizing value. The silica in them consists in part of the siliceous "skeletons" of a low order of vegetable life, which is aquatic. Such material, when free from sand, is used for fine polishing.

ASHES OF COTTON SEED HULLS.

To prepare cotton seed for grinding and pressing, it is "decorticated" or hulled. The hulls make up about half the entire weight of the seed. They have no value as food, and at the mills are used for fuel in connection with wood or coal. As the analyses show, the ash of the hulls burned alone or with some wood is very valuable as a fertilizer, containing over 20 per cent. of potash and 9 to 13 per cent. of phosphoric acid.

When burned with coal the ashes would be of very inferior value or worthless. When the ashes of the hulls can be got clean from coal ash, they are well worth the price which has been asked for them.

Below are given the analyses of two samples made here during the year, the average of seven analyses of cotton hull ashes from the market and an analysis of the pure ash, free from any wood ashes, sand, coal and carbonic acid, made by Dr. C. W. Dabney, Jr. (Rep. N. C. Exp't Station, 1882, p. 99):

	852	909	Average composition.	Pure ash of Hull.
Potash,	25.83	26.79	21.89	57.95
Lime,				7.28
Magnesia,				15.53
Oxide of iron,				1.87
Alumina,				0.45
Phosphoric acid,	12.95	9.65	10.11	4.07
Sulphuric acid,				4.18
Soluble silica,				1.67
Chlorine,				2.39
Soda, undetermined and loss,				4.61
Water,	5.69	12.10	15.02	
Insoluble in acid.		11.63	12.45	
				100.00

The solubility of the phosphoric acid in **852** and **859** was as follows:

	852	909
Phosphoric acid, soluble in water,	.90	3.49
" " " in ammonium citrate,	7.96	5.39
" " insoluble in water and am. cit.,	4.09	.77
	12.95	9.65

COMPOSITION OF HOUSE ASHES.

1026. Ashes from 46¾ lbs. of Gray Birch from Holderness, N. Hampshire. The wood was 2–6 inches diameter, 18 inches long and well seasoned. The ash as analyzed weighed 1 lb. 1⅛ oz.

1032. Ashes from 105¾ lbs. of well seasoned hickory wood. Sticks 2 feet long, 2–7 inches diameter. The ash weighed 2 lbs. 2 oz.

1040. Ashes from 105¼ lbs. of well seasoned oak wood. Sticks 2 feet long, 1½ to 6 inches diameter. The ash weighed 1 lb. 1½ oz.

1051. Ashes from 55½ lbs. of well seasoned chestnut wood. Sticks 1 foot long, 6–12 inches diameter. Cut on the Station land one year ago. The ashes weighed $4\frac{4}{10}$ oz.

1032 and **1040** were from wood bought of a dealer in New Haven and probably grown in this State.

All of these woods were burned on a clean brick hearth without the addition of any other kind of fuel. The bits of charcoal, left from the fire were sifted out and burned by themselves and the ash from them was added to the other. With these analyses are given analyses of ashes from the same kinds of wood which were prepared by G. H. Glover, Esq., of North Branford, in a stove, and noticed in the report of this Station for 1879, page 45. [Nos. **253, 254, 255.**] The amount of insoluble matter [sand, etc.] in them is much larger than in the others.

Next in the table is given the average of 13 analyses of wood from household fires as reported by Dr. F. H. Storer (Bull. Bussy Institution, part III, 1874, p. 193).

The last column of the table represents the average composition of unleached Canada ashes calculated from 13 analyses published in Bulletins II and IV of the Massachusetts Agricultural Experiment Station.

	Birch.	Hickory.		Oak.		Chestnut.		Average of 13 analyses by Storer.	Canada Ashes Unleached.
	1026	**1032**	**255**	**1040**	**254**	**1051**	**253**		
Potash	8.15	7.54	4.56	9.26	9.37	3.96	3.07	8.50	5.77
Soda	.43	1.57	.53	1.38	1.92	.92	.42		
Lime	35.31	42.60	36.29	43.20	29.65	39.72	29.15		38.99
Magnesia	4.36	6.51	5.71	4.28	3.65	5.82	9.63		
Oxide of Iron and Alumina,	.73	.56	2.79	.98	3.73	2.61	5.21		
Phosphoric acid	2.30	2.19	1.63	1.92	2.42	1.69	2.51	2.04	1.17
Sulphuric acid	.39	.90	.99	.96	1.88	1.08	2.46		
Chlorine		.16	.19	.63	1.49		.17		
Carbonic acid	26.72	31.65	23.22	27.45	16.57	24.00	12.80	25.53	
Sand and Silica	10.30	3.70	18.09	7.15	22.07	15.80	26.70	6.97	7.07
Charcoal	6.65	.88	1.51	.85	1.97	2.40	3.26		
Water	4.05	1.93	4.49	1.35	5.28	1.80	4.62		11.40
Undetermined	----	----		----	----	----	----	----	----
	99.39	100.19	100.00	99.41	100.00	99.80	100.00		
Per cent. of crude ash in the wood	2.27	2.01		1.04		.50			

The two samples of chestnut ashes differ remarkably from oak, birch and hickory ashes in having very much less potash. A large number of analyses would be necessary to decide whether this difference is more than an accidental one. Canada ashes apparently have rather less potash and phosphoric acid than clean burned birch, hickory and oak, and less than the average of ashes from house fires as found by Dr. Storer.

A cord of hickory wood, as we are informed by wood dealers in this city, weighs from 3400 to 4300 lbs. and on the average about 3500 lbs. A cord of oak wood weighs from 2300 to 2400 lbs. The weight of birch and chestnut wood per cord could not be ascertained.

From these figures and the analyses, the amounts of potash and phosphoric acid recoverable in the ashes of a cord of oak and of hickory are found to be as follows:

	Oak.	Hickory.
Potash,	2.3	4.3 lbs.
Phosphoric acid,	.5	1.3

LEACHED WOOD ASHES.

1024. Made by J. F. Bartlett, Winsted. From stock of J. L. Bartlett, Simsbury. Sampled and sent by L. G. Goodrich, Simsbury.

1038. From stock of J. E. Wardwell, Southport.

1039. From stock of N. Alvord, Southport.

The last two samples were sent by E. C. Birge of Southport.

ANALYSES.

	1024	1038	1039
Potash,	1.33	1.54	1.41
Soda,	1.30	.78	.63
Lime,	24.69	26.92	26.85
Magnesia,	2.63	2.70	2.10
Oxide of iron and alumina,	4.16	2.27	2.17
Phosphoric acid,	1.86	1.24	1.15
Sulphuric acid,	0.19		
Carbonic acid,	16.39	17.25	16.94
Insoluble in acids and silica,	15.60	10.19	5.81
Charcoal,	2.61	2.67	1.81
Water,	28.58	33.03	39.65
Undetermined and loss,	.66	1.41	1.48
	100.00	100.00	100.00
Weight of one bushel,		63 lbs.	62 lbs.
Cost per bushel,	19c.	14c.	14c.

All the samples are of good quality.

SWAMP MUCK.

842. Peat, No. 1. Taken from the middle of a swamp. The layer was over 8 feet deep.

843. Peat, No. 2. Taken from the edge of a swamp. The layer 3 feet deep.

These two samples were sent by G. M. Denison, New London, Conn.

857. Muck sent by A. P. Hine, Torrington, Conn.

1017. Muck sent by Prof. B. F. Koons of the Storrs Agricultural School, Mansfield, Conn.

ANALYSES.

The fresh material contains—	842	843	857	1017
Water,	85.46	74.47	75.03	79.49
Organic and volatile matters,	13.88	10.21	17.31	18.38
Ash,	.66	15.32	7.66	2.13
	100.00	100.00	100.00	100.00
With nitrogen,	.23	.32	.46	.47

The ash contains—	842	843	857	1017
Silica and insoluble,	.30	14.38	7.25	1.12
Oxide of iron, alumina, and phosphoric acid,		.52	.15	.26
Lime,	.12	.17	.16	.43
Magnesia,				.11
Undetermined,	.24	.25	.11	.22
	.66	15.32	7.66	2.13

The dry muck contains—	842	843	857	1017
Organic and volatile matters,	95·46	39.95	69.32	89.62
Nitrogen,	1.58	1.24	1.84	2.30
Silica and insoluble,	2.08	56.32	29.03	5.45
Oxide of iron, alumina, etc.,		2.04	.56	1.26
Lime,	.82	.68	.64	2.10

Review of the Fertilizer Market.

Organic nitrogen in dried blood and azotin was quoted in New York *at wholesale* in November, 1882, at $19.70 to $20.10 per 100 pounds. The same prices ruled through December and January. Since then its cost in dried blood has steadily declined, and in November, 1883, stood at from $13.70 to $15.20. From March till August the cost in azotin remained at $18.90, then dropped again, and in November, 1883, it was quoted at $15.20 per 100 pounds.

According to thirteen analyses of ammonite, dried blood and fish scrap, made at the New Jersey Station in the Spring of 1883,* the average retail cost of nitrogen in those articles was $20.08 per 100 pounds.† The highest price was $22.90; the lowest, $15.50. These were *manufacturers' cash retail prices* for ton lots, including bags, but not freightage nor the charges of middlemen.

The cost of nitrogen in dried fish scrap, containing from 5.3 to 8.3 per cent. of phosphoric acid and from 2.9 to 8.5 per cent. of nitrogen, from the stock of *retail agents* in this State, has ranged from $22.70 to $48.26 per 100 pounds.

Rejecting this highest figure the average retail cost in six articles has been $24.54.

Nitrogen in four samples of castor pomace from *retail agents* in this State has cost from $17.05 to $18.76 per 100 pounds, averaging $17.79; and the average cost in three samples of cotton seed meal has been the same, $17.81.

Nitrogen in ammonia salts cost *at wholesale* in New York, in November, 1882, $22.20 per 100 pounds. Since then it has quite steadily declined, and was quoted in November last at $16.40.

In the New York and Philadelphia markets it cost *at retail in ton lots*, including packages, from $19.75 to $21.50 per 100 pounds;‡ average cost, $20.78.

Two samples from the stock of *retailers* in this State furnished nitrogen at $22.90 and $23.35.

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* Bulletin XXVII, N. J. Exp't Station.

† Allowing six cents per pound for the phosphoric acid present in the goods.

‡ Bulletin XXVII, N. J. Exp't Station.

Nitrogen in nitrates has this year, as last, cost less at wholesale than in any other form. In November, 1882, it was quoted at *wholesale* in New York at $17.60 per 100 pounds. In January it rose to $17.90, fell again in May to $16.30, declined still further in the Summer, and in November, 1883, stood at $15.20 per 100 pounds.

Last Spring in New York and Philadelphia it was bought of *importers at retail in ton lots* at from $18.40 to $20.60 per 100 pounds, $19.65 on the average.

The two samples analyzed here from stock of *retail dealers* in this State furnished nitrogen at $22.61 and $21.67 per 100 pounds.

Phosphatic materials have not shown striking fluctuations. The wholesale New York quotation for *bone black* in November, 1882, was $24.50 per ton. It remained at that figure till March, declined to $21.50 in June, and has since remained steady at $22.00.

Charleston rock, crude, in New York, was quoted at $9.00 per ton in January, 1882. It fell to $8.50 in March, and still remains at that figure.

Ground bone, quoted at $33.50 in November, 1882, rose in April to $35.00, and declined in June to $32.00, where it still remains.

Sulphuric acid, 66°, was quoted at 1½ cents per pound from November, 1882, to July, 1883, and since then has been quoted at 1⅜ cents.

In plain superphosphates, containing over ten per cent. of soluble phosphoric acid, the latter has cost* $9.80 per 100 pounds *at retail for cash*, bought of the manufacturers. No allowance is made for reverted and insoluble phosphoric acid. Such an allowance would make the soluble acid cost still less.

Only two analyses of plain high grade superphosphates from the open market have been made at this Station during the year. They furnished soluble phosphoric acid at $10.02 to $11.20 per 100 pounds.

Actual potash in high grade muriate cost in New York *at wholesale* in December, 1882, $3.58 per 100 pounds, which is the highest figure for the year. In November, 1883, it was quoted at $3.20. It has *retailed* in Connecticut during 1883 for $3.87 to $4.36 per 100 pounds.

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* Average of nine analyses, Bulletin XXVII, N. J. Exp't Station.

Kainit has not fallen in price. In December, 1882, it cost *at wholesale* in New York $8.62 per ton; it has been as low as $7.47, but in November last was quoted at $8.75, the highest price of the year.

Since kainit contains on the average 12½ per cent. of actual potash, the wholesale cost of potash in kainit at $8.75 per ton is $3.50 per 100 pounds. Its *retail price* in ton lots in New York and Philadelphia* was, last Spring, $4.52 per 100 pounds, but in this State it has retailed as high as $7.38.

To recapitulate: Charleston rock has remained steady, bones and bone black have fallen slightly, and oil of vitriol is a shade lower perhaps, but in general we may say that phosphoric acid is not much cheaper this year than last.

Tankage, red and black blood, azotin, nitrate of soda and sulphate of ammonia have all fallen very considerably in price. It should be, and will be possible by using care in buying, to get them at a less cost than a year ago.

Potash as muriate is a little lower this year than last; as kainit it is at present a shade higher.

The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged, and this average is taken as the quotation for the month. The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

Phosphate rock, *kainit*, *bone*, *fish scrap*, *tankage*, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by an analysis at the time of purchase.

Sulphate of ammonia, *nitrate of soda and muriate of potash* are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, *azotin and ammonite* are quoted at so much "per unit of ammonia." A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of dried blood has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $3.75 per unit, a ton of it will cost 8½ × 3.75 = $31.88.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

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* Bulletin XXVII, N. J. Exp't Station.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given:

Ammonia at	$4.00	per unit is	equivalent to	nitrogen at	24.3	cts.	per lb.
"	3.90	"	"	"	23.7	"	"
"	3.80	"	"	"	23,0	"	"
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.2	"	"
"	2.90	"	"	"	17.6	"	"
"	2.80	"	"	"	17.0	"	"
"	2.70	"	"	"	16.4	"	"
"	2.60	"	"	"	15.8	"	"
"	2.50	"	"	"	15.2	"	"
"	2.40	"	"	"	14.6	"	"
"	2.30	"	"	"	14.0	"	"
"	2.20	"	"	"	13.4	"	"
"	2.10	"	"	"	12.8	"	"
"	2.00	"	"	"	12.2	"	"

Commercial sulphate of ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	5	cents per lb.	Nitrogen	costs	24.4	cents per lb.
"	4⅞	"	"	"	23.7	"
"	4¾	"	"	"	23.1	"
"	4⅝	"	"	"	22.5	"
"	4½	"	"	"	21.9	"
"	4⅜	"	"	"	21.3	"
"	4¼	"	"	"	20.7	"
"	4⅛	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	3⅞	"	"	"	18.9	"
"	3¾	"	"	"	18.3	"
"	3⅝	"	"	"	17.6	"
"	3½	"	"	"	17.0	"
"	3⅜	"	"	"	16.4	"
"	3¼	"	"	"	15.8	"
"	3⅛	"	"	"	15.2	"
"	3	"	"	"	14.6	"

Commercial nitrate of soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	3⅝	cents per lb.	Nitrogen	costs	23.2	cents per lb.
"	3½	"	"	"	22.3	"
"	3⅜	"	"	"	21.5	"
"	3¼	"	"	"	20.8	"
"	3⅛	"	"	"	19.9	"
"	3	"	"	"	19.2	"
"	2⅞	"	"	"	18.3	"
"	2¾	"	"	"	17.6	"
"	2⅝	"	"	"	16.9	"
"	2½	"	"	"	16.0	"
"	2⅜	"	"	"	15.2	"
"	2¼	"	"	"	14.4	"
"	2⅛	"	"	"	13.6	"
"	2	"	"	"	12.8	"

Commercial muriate of potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

If quoted at	2.00	cts. per lb.	Actual potash	costs	3.96	cts. per lb.
"	1.95	"	"	"	3.86	"
"	1.90	"	"	"	3.76	"
"	1.85	"	"	"	3.66	"
"	1.80	"	"	"	3.56	"
"	1.75	"	"	"	3.46	"
"	1.70	"	"	"	3.36	"
"	1.65	"	"	"	3.26	"
"	1.60	"	"	"	3.16	"
"	1.55	"	"	"	3.06	"
"	1.50	"	"	"	2.96	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, during the last 27 months. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt. For three months azotin and ammonite were not quoted at all.

	COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH AT WHOLESALE IN
	Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1881. May	21.3	21.8	21.9	24.7	3.78
June	21.5	21.8	21.1	24.8	3.86
July	22.0	21.8	20.8	25.6	3.92
August	22.4	22.1	20.8	25.2	4.06
September	23.8	....	20.9	24.7	3.78
October	23.0	24.3	20.8	24.9	3.64
November	23.3	24.3	20.4	25.6	3.62
December	23.1	....	20.3	25.7	3.60
1882. January	23.0	....	19.9	25.6	3.71
February	22.3	22.2	19.8	25.6	3.60
March	19.6	20.1	18.3	25.0	3.36
April	19.7	19.7	18.4	23.8	3.24
May	19.1	19.7	18.3	22.7	3.26
June	18.9	19.7	16.9	22.4	3.28
July	19.8	19.5	16.8	22.4	3.40
August	19.5	19.5	16.8	22.4	3.52
September	19.7	20.3	17.7	22.4	3.60
October	19.7	20.1	17.8	22.3	3.56
November	19.7	20.0	17.6	22.2	3.56
December	19.7	20.1	17.6	21.8	3.58
1883. January	19.7	20.1	17.9	20.7	3.51
February	19.4	19.7	17.9	21.9	3.42
March	18.0	18.9	17.8	20.7	3.42
April	18.2	18.9	17.9	20.1	3.40
May	18.2	18.9	16.3	20.1	3.34
June	17.8	18.9	16.3	20.0	3.36
July	17.2	18.9	15.6	19.0	3.23
August	16.0	18.9	15.3	18.6	3.18
September	15.3	17.0	14.8	17.6	3.21
October	15.0	15.2	14.8	17.3	3.12
November	14.5	15.2	15.2	16.4	3.20

ON THE COMPOSITION OF LEAVES AT DIFFERENT PERIODS OF GROWTH.

Dead leaves collected in the fall are valued for litter and as an absorbent in stables, but it is generally understood have no great fertilizing value in themselves. The experiments of Zöller and Rissmüller have shown that while in early summer the leaves contain very considerable amounts of nitrogen, phosphoric acid and potash, these substances are withdrawn into the wood of the tree with the advancing season, so that before the leaves fade they have lost the larger part of what was most valuable in them, which the tree retains for its further use. Rissmüller's investigations on the leaves of the beech tree* show that in their dry substance the highest *percentage amount* of nitrogen, phosphoric acid and potash, is found when they open in May, and this percentage quite regularly decreases till they ripen and fall, but the *absolute* amount of nitrogen, phosphoric acid and potash is greatest in July and from that time on decreases.

From an oak tree standing on a lawn at the Station, leaves were carefully picked at three different periods, as follows:

Oct. 16. The leaves were bright green and showed no signs of fading or changing color.

Nov. 13. The leaves were brown, having almost entirely lost their reddish tinge. Leaves were falling from the tree, but not rapidly. It retains part of its leaves till the buds start in the spring.

March 17. The upper branches were quite bare, but the lower ones had still many leaves.

Two samples of leaves from a chestnut tree (*Castanea vesca*) which stands on the Station land were also gathered on the following dates:

Oct. 16. The leaves were green and unfaded.

Nov. 13. The leaves were ripe and ready to fall.

The tree was nearly bare and the next day was entirely so.

ANALYSES OF THE FRESH LEAVES.

	Oak.			Chestnut.	
	Oct. 16.	Nov. 13.	Mar. 17.	Oct. 16.	Nov. 13.
Water	56.630	29.743	10.496	60.215	31.675
Albuminoids	5.287	3.403	3.898	4.314	4.215
Fiber	9.185	20.379	24.322	6.705	13.395
Non-nitrogenous Extract	24.938	39.335	52.858	23.473	42.333
Ether Extract	1.630	3.340	3.898	3.480	5.407
Ash	2.330	3.800	4.528	1.813	2.975
	100.000	100.000	100.000	100.000	100.000

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* Landwirthschaft. Versuchs-Stationen XVII, 30.

The ash contains:

	Oak.			Chestnut.	
	Oct. 16.	Nov. 13.	Mar. 17.	Oct. 16.	Nov. 13
Potash	.326	.173	.072	.353	.384
Soda	.015	.029	.005	.016	.021
Lime	.688	1.426	1.817	.404	.864
Magnesia	.162	.288	.284	.928	.443
Oxide of Iron	.081	.077	.119	.181	.164
Phosphoric Acid	.263	.260	.084	.186	.230
Sulphuric Acid	.060	.090	.154	.086	.149
Carbonic Acid	.418	.815	1.229	.259	.512
Silica and insoluble in acid	.317	.642	.764	.100	.208
	2.330	3.800	4.528	1.813	2.975

To facilitate comparison, these analyses are reduced to a water-free basis.

Albuminoids	12.19	4.84	4.36	10.84	6.17
Fiber	21.18	29.00	27.17	16.86	19.60
Non-nitrogenous Extract	57.50	55.98	59.06	58.99	61.93
Ether Extract	3.76	4.76	4.36	8.75	7.93
Ash	5.37	5.42	5.05	4.56	4.37
	100.00	100.00	100.00	100.00	100.00

The ash contains:

Potash	.75	.25	.08	.89	.56
Soda	.04	.04	.01	.04	.03
Lime	1.58	2.03	2.03	1.02	1.28
Magnesia	.37	.41	.32	.57	.61
Oxide of Iron	.19	.11	.13	.46	.24
Phosphoric Acid	.61	.37	.09	.47	.34
Sulphuric Acid	.14	.13	.17	.21	.22
Carbonic Acid	.96	1.16	1.37	.65	.75
Silica and insoluble	.73	.92	.85	.25	.31
	5.37	5.42	5.05	4.56	4.37

The leaves gathered on Oct. 16th had very nearly finished their assimilating function, those gathered Nov. 13th we may assume had nearly or quite ceased to lose through resorption into the wood, and those gathered March 17th represented dead leaves which had been exposed to leaching and the action of frost for nearly four months.

The green oak leaves lost between one-third and one-half of the percentage of nitrogen in their dry substance, between the time that they began to change color and the time when they became brown ("dead"). The corresponding gain is found chiefly in the fiber and also in the ether extract. The relative amount of potash in the second period is only one-third of what it is in the first, the relative amount of phosphoric acid is much less, while lime, silica and phosphoric acid are relatively more abundant.

The same changes to a less extent are noticed in the chestnut leaves, except that there is a loss instead of a gain in ether extract.

These analyses show the composition of the leaves at different periods, they do not *prove* an absolute loss of nitrogen, potash, etc., during the fading of the leaves, though such a loss no doubt occurs. The *percentage* amounts of these elements can be lessened either by the withdrawal of them from the leaves or by the further deposit of fiber, fat, etc., in the leaves.

Between Nov. 13th and March 17th, the dry matter of the oak leaves has become, pound for pound, somewhat poorer in nitrogen, fiber and ash, and the ash has lost in large part its potash and phosphoric acid. In this case the loss must be absolute as well as relative, for there can scarcely be any other than a physical connection between the leaf and the wood of the tree. The loss has been occasioned by the weathering and leaching of the leaves in the winter storms.

From the analyses of the oak and chestnut leaves gathered on Nov. 13th, it is seen that the newly fallen leaves, with about 30 per cent. of water, contained in 100 lbs:

	Oak.	Chestnut.
Nitrogen	.54 lbs.	.67 lbs.
Potash	.17	.38
Phosphoric acid	.26	.23

Stable manure with 70 per cent. of water, contains about .5 lbs. nitrogen, .4 lbs. potash and .5 lbs. phosphoric acid. While the nitrogen in stable manure is readily available, it is likely that that of fallen leaves is comparatively inert.

The amount of leaves which fall yearly, according to Ebermayer,* varies considerably, being larger in wet seasons than in dry, larger on a rich soil than on a poor one. It also varies with the thickness of the woods. Other things being equal, trees produce more foliage when standing apart than when standing in dense woods.

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* Versuchs-Stationen: XVIII, 63.

Nor is the composition of the fallen leaves, at least of the ash constituents, at all constant. J. Nessler* found in the dry substance of newly fallen oak leaves, phosphoric acid and potash as follows:

	Phosphoric Acid.	Potash.
1867	.224 per cent.	.347 per cent.
1868	.073 "	.232 "

and in dry beech leaves:

1867	.360	.503
1868	.104	.282

Similar observations were made by Zöller and Rissmüller.

Composting Dead Leaves.

Under date of March 31, 1883, Mr. George A. Ross, of Jewett City, writes as follows:

I wish to make a compost heap of the following:

Dead leaves that have drifted behind a wall for the last 25 years and more, also the soil under these leaves, which is a dark brown loam filled with small roots; and unslaked lime.

1st. Now how shall I compost it?

2d. In what proportion shall I use the lime and loam?

3d. Shall I use the lime unslaked or slaked, at first?

4th. Shall I let it stand a year?

I should be very happy to hear you make any suggestion that you think will benefit me.

To Mr. Ross was replied in substance:

1st. Use fresh slaked lime.

2d. One bushel of unslaked lime to 15 or 20 of the loam would probably be an ample quantity. (1 bush. of lime to 10 of pure swamp-muck is enough.)

3d. Mix or interstratify well. Put down 20 bushels, two or three inches deep, then sprinkle on the one bushel of lime still warm from the slaking. Add another layer of loam and another of lime, and so on until the heap is several feet high.

4th. The heap may remain through a summer and may then be mixed by cutting down and shoveling over.

5th. If a bushel of salt (to six bushels of lime) be dissolved in water and the brine be used to slake the lime, the action will be much more rapid and a few weeks will suffice to set up a decomposition, when the heap may be overhauled, and the compost will be ready in a few weeks more.

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* Jahresbericht Ag. Chem., XI, 360.

6th. Instead of salt, muriate of potash may be advantageously used. It will probably act as well in the compost and will also supply indispensable potash to the crops.

The favorable effect of "salt and lime mixture" is explained in my Report on "Peat and Its Uses as Fertilizer and Fuel," page 73, as follows:

"When quick-lime is slaked with a brine of common salt (chloride of sodium), there are formed by double decomposition, small portions of caustic soda and chloride of calcium, which dissolve in the liquid. If the solution stand awhile, carbonic acid is absorbed from the air, forming carbonate of soda; but carbonate of soda and chloride of calcium instantly exchange their ingredients, forming insoluble carbonate of lime and reproducing common salt. When the fresh mixture of quick-lime and salt is incorporated with any porous body, as soil or peat, then, as Graham has shown, unequal diffusion of the caustic soda and chloride of calcium occurs from the point where they are formed, through the moist porous mass, and the result is, that the small portion of caustic soda which diffuses most rapidly, or the carbonate of soda, formed by its speedy union with carbonic acid, is removed from contact with the chloride of calcium.

Soda and carbonate of soda are more soluble in water and more strongly alkaline than lime. They, therefore, act on peat more energetically than the latter. It is on account of the formation of soda and carbonate of soda from the lime and salt mixture, that this mixture exerts a more powerful decomposing action than lime alone. Where salt is cheap and wood ashes scarce, the mixture may be applied accordingly to advantage. Of its usefulness we have the testimony of practical men."

Case of Poisoning with Paris Green.

"East Hartford, Sept. 25, 1883.

Prof. S. W. Johnson:

Dear Sir:—Here inclosed I send you a portion of the bowel of a horse for analysis, which I have very strong suspicion was poisoned. Dr. Cressy made the post-mortem examination, and is of that opinion also. An early reply will greatly oblige

Yours very truly,
Jno. E. Lathrop."

The material came to hand on the 29th of September, and was immediately examined. It contained both copper and arsenic, which, with acetic acid, are the constituents of Paris green (aceto-arsenite of copper). Paris green was, therefore, undoubtedly the cause of death.

FEEDING STUFFS.

Twenty samples of feeding stuffs have been under examination during the year, as follows:

Meal from entire corn	1	sample.
Hominy meal	6	"
Gluten meal	2	"
Wheat middlings	3	"
Shorts	1	"
Bran	1	"
Cotton seed meal	3	"
New process linseed meal	1	"
Dried grains from ale brewery	1	"
Steam-dried brewers' grains	1	"
	20	

Maize Meal and Hominy Feed.

[See Table of Analyses on page 78.]

CLVIII. Meal from entire corn. From stock of W. H. Childs, of North Manchester. Sent by H. A. Slater, of North Manchester. Price in February, 1883, $30.00 per ton. This meal is rather below the average as regards its content of fat.

The next six analyses are of "hominy feed;" also called "Baltimore meal" or "white meal." This material is a by-product in the manufacture of hominy. It consists of the hull of the corn and of the soft portions around the chit.

CLIV and CLVII were sent by Oliver Rice, of Meriden. Cost $1.30 per 100 pounds at retail, $23.00 per ton in car lots in Meriden in February, 1883.

CLX. Sent by H. A. Slater, from stock of W. H. Childs, North Manchester. Price, $25.00 per ton in February, 1883.

CLXIII. Sent by Andrew Kingsbury, Coventry. Price, $1.25 per 100 pounds (yellow corn meal retailing at $1.40).

CLXIV. Sent by N. P. Perkins, Willimantic, from stock of J. C. Bugby & Co. Price, $1.25 per 100 pounds in June, 1883 (yellow corn retailing at $1.40 per 100 pounds).

ANALYSES.

	Maize Meal.	Hominy Chops, Hominy Feed, Baltimore Meal or White Meal.					
	CLVIII.	CLIV.	CLVII.	CLX.	CLXIII	CLXIV.	CLXXIII.
Water	18.81	8.65	11.14	13.46	12.91	10.64	11.46
Ash	1.30	....	2.32	2.54	....	3.39	2.30
Albuminoids	8.81	8.69	9.50	9.75	9.00	8.69	7.88
Fiber	1.35	....	2.54	2.79	....	....	3,30
Nitrogen-free Extract (Starch, Sugar, etc.)	67.37	....	67.66	64.27	....	....	67.68
Fat	2.36	7.16	6.54	7.19	7.17	5.95	7.38
	100.00		100.00	100.00			100.00
Cost per ton	$30.00	$23.00*	$23.00*	$25.00			$23.00
" " 100 lbs.		$1.30	$1.30		$1.25	$1.25	$1.20

Water Free.

Ash	1.60	....	2.62	2.93	....	3.79	2.60
Albuminoids	10.85	9.53	10.73	11.27	10.33	9.71	8.89
Fiber	1.66	....	2.86	3.22	....	....	3,73
Nitrogen-free Extract (Starch, Sugar, etc.)	82.98	....	76.46	74.26	....	....	76.54
Fat	2·91	7.85	7.33	8.32	8.23	6.65	8.24
	100.00		100.00	100.00			100,00

* In car lots.

CLXXIII. Sent by O. L. Buell, West Simsbury, from stock of J. & H. Woodford, Avon. Cost $1.20 per 100 pounds, or $23.00 per ton in December, 1883.

On the average hominy meal contains 9.3 per cent. of albuminoids and 7.5 per cent. of fat; maize meal, 9.0 of albuminoids and 3.8 of fat: and flint corn, 10.9 of albuminoids and 4.9 of fat.

Presumably the albuminoids and fat in hominy meal are severally as digestible as they are in ordinary maize meal. They are cheaper, and the relative quantity of them, especially of the fat, is larger. For these reasons it appears that, as far as can be judged *from chemical analysis*, it is more economical at the prices given to use hominy meal in a ration than corn meal. Experience in its use must decide whether it is as healthful as maize meal, and whether in the case of milk cows it has a favorable or unfavorable effect on the milk yield, or imparts any peculiar flavor to the milk. In substituting it for corn meal, it should be considered that hominy meal contains twice as much fat as corn meal, and the ration should be modified accordingly. This large proportion of fat evidently makes it needful to use some caution as to the quantity fed.

Mr. N. P. Perkins, of Willimantic, writes that he and others of the same place, are feeding hominy meal instead of yellow corn meal to milch cows, with good results. The cows keep in excellent condition and give more milk than on yellow corn meal. The daily ration per cow is 4 quarts hominy meal, 2 quarts wheat bran and 2 quarts of "fine feed," well mixed and fed wet; one-half in the morning and the other half at night.

Mr. Perkins also feeds it to horses and hogs in the same way that maize meal is fed. But in fatting cattle it cannot be quite so freely used as the maize meal. A fatting cow which ate a peck of the latter daily became cloyed when a peck of hominy meal was substituted, and refused it altogether.

Mr. A. Kingsbury, of Coventry, also reports favorably with regard to using hominy meal for cows.

Gluten Meal.

CLV. Sent by Burdett Loomis, Hartford, February, 1883.

CLXXII. Sampled and sent by Newton & Fuller, Springfield, Mass., from their stock. Price in November, 1883, $1.40 per 100 pounds.

Analyses.

			Water free.	
	CLV.	CLXXII.	CLV.	CLXXII.
Water	10.73	10.54		
Ash	.72	.67	.80	.75
Albuminoids	31.75	30.00	35.54	33.53
Fiber	1.26	.60	1.40	.67
Nitrogen-free extract	50.57	54.93	56.69	61.42
Fat	4.97	3.26	5.57	3.63
	100.00	100.00	100.00	100.00

Gluten meal is a by-product in the manufacture of glucose, which has lately come into the market. It is not easy to compare this with the ordinary kinds of feed. It ranks among concentrated feeding stuffs, because of its large content of albuminoids (or protein). Beans with 24 per cent., linseed cake with 29 per cent., and malt sprouts with 26 per cent. of albuminoids come nearest to it in respect to this, the most costly element of food. The gluten meal is, however, richer in fat than beans or malt sprouts, and much less rich than linseed and cotton seed meal. It most resembles the "new process" linseed meal, which contains on the average 35½ per cent. of albuminoids and 4½ per cent. of fat, and it is likely that its feeding value will approach that of "new process" linseed. Actual use in feeding can alone decide positively its value, which, from its source and its composition, is presumably high. Its proper use is in connection with coarse and unconcentrated foods, to supply their deficiency of albuminoids.

Dried Brewers' Grains.

CLVI. Dried grains from ale brewery. Sent by Burdett Loomis, Hartford, February, 1883.

CLXVII. "Dried Brewers' Grains for Horse and Cattle Feed." Prepared by the Concentrated Feed Company, 422 East 62d St., New York City. Sample drawn from a bag of 100 pounds presented to the Station by the company.

Analyses.

			Water free.	
	CLVI.	CLXVII.	CLVI.	CLXVII.
Water	6.23	11.91		
Ash	3.31	3.63	3.53	4.11
Albuminoids	19.25	20.25	20.53	22.98
Fiber	10.24	11.60	10.92	13.17
Nitrogen-free extract	56.80	46.10	60.58	52.37
Fat	4.17	6.51	4.44	7.37
	100.00	100.00	100.00	100.00

The prejudice against brewers' grains, which has been quite general, has arisen largely from the improper feeding of them and from the fact that, being very wet, they spoil quickly and have to be brought from the brewery fresh every day or two, or else are liable to be fed sour unless pitted or ensilaged. When properly fed they give excellent results.

The Concentrated Feed Company now prepare them by drying, so that they can be kept indefinitely. In composition they differ from gluten meal by containing some 12 per cent. less of albuminoids and 10 per cent. more of fiber, with 2 per cent. more of ash.

WHEAT BRAN, MIDDLINGS AND SHORTS.

CLXVIII. Wheat bran. Sent by M. C. Dean, from stock of E. W. Spurr, Falls Village. Cost $20 per ton on cars in August, 1883.

CLXI. "White middlings." Sent by H. A. Slater, North Manchester, from stock of W. H. Childs. Cost $28 per ton in February, 1883.

CLXV and CLXVI. Wheat middlings. Sent by H. Page, Durham Center.

CLIX. Shorts. Sent by H. A. Slater, North Manchester, from stock of W. H. Childs.

ANALYSES.

	Bran.	Wheat Middlings.			Shorts.
	CLXVIII.	CLXI.	CLXV.	CLXVI.	CLIX.
Water	14.18	13.85	11.62	11.35	13.59
Ash	5.97	2.45	....	....	5.23
Albuminoids	12.69	15.00	14.25	14.31	13.87
Fiber	7.69	1.27	....	....	8.99
Nitrogen-free Extract	56.21	63.70	....	....	55.62
Fat	3.26	3.73	3.50	3.98	2.70
	100.00	100.00			100.00

Water Free.

Ash	6.95	2.84	....	....	6.05
Albuminoids	14.79	17.41	16.11	16.15	16.05
Fiber	8.97	1.48	....	....	10.40
Nitrogen-free Extract	65.50	73.94	....	....	64.37
Fat	3.79	4.33	3.96	4.49	3.13
	100.00	100.00			100.00

CLXV and CLXVI represent two different lots of wheat middlings offered to the sender, who wished to know which was the better article. CLXVI has about one-half a per cent. more of fat in it, which, other things being equal, would make it more valuable. To Mr. Dean's inquiry with regard to the sample of wheat bran sent by him answer was made as follows:

"Your questions, as to the value for feeding and for manure of this sample, are not easy to answer. The value of bran as of any other similar kind of feed depends upon the place in the ration, bran alone being a very poor feed, while bran in suitable mixture with other fodders is very valuable. In the Reports of this Station and in "Armsby's Manual of Cattle Feeding," also in a recent book by Stewart on the same subject this matter is more or less fully discussed. You will find in the Station Report of 1881, a paper by Dr. Armsby, pp. 90 to 105, which will give you the principal points. As to the value of the manure, I can only say that the richer the food, other things being equal, the richer will be the manure. Bran contains an abundance of nitrogen and phosphates. In the mature animal these ingredients pass entirely into the manure when the animal is not increasing in weight or giving milk or nourishing young. The manure from bran fed animals will therefore be richer in these elements than that furnished by hay-fed cattle. As to feeding, one word further: but a limited, rather small amount of bran can be fed to an animal without injury to its health. The proper use of bran in a cattle ration is as an addition to common hay or other coarse feed and the coarsest feed like straw and chaff may be advantageously fed to animals when a suitable quantity of bran or similar concentrated feed is used at the same time."

COTTON SEED MEAL AND NEW PROCESS LINSEED MEAL.

CLXII. Cotton Seed Meal. Sent by Wm. Smith, of Plainville, from stock of G. Richards & Co., Unionville. Cost, $31.00 per ton. Its analysis as a fertilizer will be found on page 57, No. 876.

CLXX. Cotton Seed Meal. Sent by H. S. Frye, Poquonock.

CLXXI. Cotton Seed Meal. Sent by A. E. Holcomb, Poquonock.

These two samples were from stock of F. Ellsworth, Hartford. Cost $30.00 per ton in November, 1883.

CLXIX. New Process Linseed Meal. Made by Cincinnati Linseed Oil Co. Sample drawn Nov. 1, 1883, from five 100-lb. bags, presented by the company to this Station.

ANALYSES.

	Cotton Seed Meal.			New Process Linseed Meal.
	CLXII.	CLXX.	CLXXI.	CLXIX.
Water	....	7.61	7.29	13.35
Ash	....	6.53	6.85	6.08
Albuminoids	43.44	46.12	45.31	34.25
Fiber	....	4.90	5.32	8.00
Carbhydrates	....	21.67	21.93	37.02
Fat	....	13.17	13.30	1.30
		100.00	100.00	100.00

Water Free.

Ash	7.06	7.38	7.00
Albuminoids	49.91	48.87	39.51
Fiber	5.30	5.74	9.22
Carbhydrates	23.48	23.67	42.78
Fat	14.25	14.34	1.49
	100.00	100.00	100.00

The samples of Cotton Seed Meal are of average quality. This material has been used to some extent as a fertilizer in this State and when it has been damaged by water, smoke, etc., or has become musty, this is the only use to be made of it; but the clean fresh meal can most economically be used first as cattle food and then as a fertilizer. When the nitrogen of any such material can with small outlay of money or time be converted into milk or beef it is certainly wasteful to turn it back into the ground and after nine months or a year recover it again in vegetables or grain. That part of the cotton seed, not assimilated by the cattle is saved in their manure and may then be applied to the land.

The "new process" of preparing linseed meal effects a more complete exhaustion of the oil or fat contained in the cake after it has been pressed. Linseed "cake" as will be seen from the table following, has about 29.7 per cent. of albuminoids and 11¼ per cent. of fat. Nearly all of this fat is removed by the new process and the meal after the extraction contains, pound for pound, more albuminoids than the cake.

CLXIX contains less oil than any sample previously examined here, though the albuminoids are not proportionally high.

It is of no special advantage to the farmer that the oil should be so perfectly extracted (for a certain amount of fat is desirable in the ration), unless by this means the feed can be bought cheaper or rather unless the albuminoids, pound for pound, cost him less. The necessary fat in the ration can be then supplied in cheaper form from cotton seed.

TABLE OF THE COMPOSITION OF AMERICAN FEEDING STUFFS.

By DR. E. H. JENKINS.

On the following pages is given the average composition of the fodders commonly used in the country, compiled exclusively from American analyses. The compiler has aimed to bring together all analyses which have been published and could be obtained up to September 1st, 1883. Probably a few have been overlooked.

In the first column of the tables is given the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

It is very desirable to know within what limits the composition of each fodder is likely to vary, and for that reason the maximum and minimum amounts of each ingredient have also been inserted in the table.

COMPOSITION OF FEEDING STUFFS.

Compiled from all available analyses made in this country—Posted to September 1, 1883.

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
GREEN FODDER.																	
Maize fodder	18	7.20	28.90	17.66	0.56	1.80	1.29	0.10	0.60	.28	3.20	17.70	9.88	1.90	9.80	5.04	1.22
Maize fodder—ensilaged	28	12.32	27.88	19.63	0.90	2.77	1.47	0.30	1.80	.72	5.62	14.23	10.12	4.04	10.02	5.96	1.36
Pea vine—ensilaged	1	----	----	18.36	----	----	2.40	----	----	.80	----	----	7.60	----	----	5.57	1.99
Rye	5	---	----	25.3†	2.30	3.00	2.60	0.60	0.70	.65	4.90	6.70	5.90	13.40	14.90	14.30	1.90
Sorghum leaves	3	23.30	32.70	27.00	2.40	3.70	3.10	----	-- -	----	----	----	15.1‡	4.30	6.80	5.20	3.50
Cow pea vines, green and succulent, with the pods	2	13.97	17.90	15.94	3.00	3.25	3.12	0.58	0.62	.60	5.34	8.46	6.91	2.87	4.09	3.48	1.83
Cow pea vines, probably after the pods were removed	1	----	----	27.19	----	----	1.85	----	----	.21	----	----	7.86	----	----	15.27	2.00
Soja bean vines	2	30.15	30.65	30.40	3.88	3.94	3.91	1.05	1.55	1.30	14.24	14.39	14.32	8.26	8.91	8.58	2.29
Carrot leaves	1	----	----	16.70	----	---	4.26	-- -	----	.86	----	----	5.99	----	----	2.25	3.34
Beet leaves	1	----	----	11.16	----	----	2.74	----	---	.60	----	----	2.49	----	----	2.50	2.83
HAY AND DRY COARSE FODDER.																	
Low meadow hay	10	85.50	93.60	89.50	4.60	10.40	7.70	0.70	3.60	2.20	39.80	55.20	43.60	21.40	40.00	30.20	5.80
Maize fodder, field cured	9	61.00	85.20	72.63	3.40	5.80	4.56	.66	1.60	1.29	30.50	49.20	38.62	18.65	30.94	23.76	4.39
Meadow hay	7	----	----	85.7†	10.10	21.50	12.40	1.60	5.10	3.10	32.70	45.20	39.60	14.90	31.70	23.00	7.60
Low meadow hay	10	85.50	93.60	89.50	4.60	10.40	7.70	0.70	3.60	2.20	39.80	55.20	43.60	21.40	40.00	30.20	5.80
Salt marsh hay	11	81.40	92.80	89.53	4.30	7.80	5.90	1.63	3.10	2.32	34.10	53.67	42.42	27.00	37.90	31.47	7.42
Timothy hay	16	----	----	85.7†	4.80	9.60	6.29	1.10	3.30	2.01	39.98	48.60	44.31	25.10	33.35	28.92	4.17
Timothy and Red top	4	----	----	85.7†	6.00	9.00	7.60	1.50	2.50	2.00	39.20	46.90	44.10	24.70	28.50	26.50	5.50
Clover hay	8	78.18	91.53	85.51	8.87	13.54	11.42	1.47	3.10	2.18	35.03	45.47	40.40	23.79	28.64	25.83	5.63
Hungarian grass hay. Reckoned to average water content	6	----	----	83.30	5.72	10.67	7.02	1.30	2.47	1.72	34.85	42.40	41.79	27.30	28.94	27.84	5.43
Black grass hay (*Juncus gerardi*)	2	88.98	91.06	90.02	6.56	7.06	6.81	2.28	2.38	2.33	43.14	49.31	46.26	24.63	29.42	27.01	7.60

* Or albuminoids.

† Calculated to average water content.

‡ Includes fat.

COMPOSITION OF FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
HAY AND DRY COARSE FODDER—*cont.*																	
Black grass hay, with seed	1	....	....	90.84	....	....	7.50	....	....	2.96	....	....	51.44	....	....	22.10	6.84
Buckwheat straw	2	89.50	89.60	89.60	3.30	4.40	3.80	1.40	1.70	1.60	32.10	34.50	32.20	44.90	46.80	45.90	5.10
Wheat straw	2	88.63	92 22	90.43	2.19	2.56	2.37	1.24	2.53	1.89	41.51	47.01	44.27	37.32	40.05	38.68	3.22
Oat straw	3	87.50	93.47	89.89	2.30	5.08	3.35	1.00	3.15	2.07	26.42	44.26	36.97	35.21	55.96	42.78	4.72
Rye straw	1	....	....	87.5†	....	....	6.89	....	....	2.68	....	....	35.70	....	....	34.20	8.03
Cow pea vines	1	....	....	89.78	....	....	19.81	....	....	1.13	....	....	34.98	....	....	23.66	10.20
ROOTS, BULBS AND TUBERS.																	
Mangolds	3	7.18	8.56	7.96	1.57	1.89	1.70	.03	.51	.20	3.56	4.91	4.19	.76	.91	.82	1.05
Ruta bagas	1	....	....	12.92	....	....	1.15	....	....	.09	....	....	9.11	....	....	1.16	1.41
Turnips	1	....	....	11.11	....	....	1.34	....	....	.09	....	....	8.11	....	....	.86	.71
Carrots	2	11.18	12.15	11.67	.97	1.35	1.16	.65	.71	.68	6.86	7.39	7.13	.86	2.32	1.59	1.11
Beets	1	....	....	12.32	....	....	1.73	....	....	.21	....	....	7.64	....	....	1.69	1.05
Onions	1	....	....	14.74	....	....	2.28	....	....	.22	....	....	10.80	....	....	.76	.68
Sweet potato	1	....	....	26.61	....	....	1.28	....	....	.28	....	....	23.00	....	....	.98	1.07
Yam	1	....	....	28.77	....	....	2.06	....	....	.25	....	....	25.24	....	....	.75	.67
FRUITS, GRAINS AND OTHER SEEDS.																	
Cucumbers	1	....	....	4.30	....	....	.83	....	....	.21	....	....	1.95	....	....	.85	.46
Tomato	1	....	....	8.74	....	....	1.00	....	....	.47	....	....	5.84	....	....	.70	.73
Squash	2	4.82	5.42	5.12	.64	.68	.66	.24	.32	.28	2.95	3.54	3.24	.53	.54	.54	.40
Peas	1	....	....	21.94	....	....	4.37	....	....	.55	....	....	14.48	....	....	1.66	.88
Apples	1	....	....	15.89	....	....	.21	....	....	.28	....	....	14.26	....	....	.91	.23
Barley	9	87.40	92.80	88.90	8.60	15.70	12.40	1.50	3.20	1.80	66.70	73.00	69.30	1.30*	4.20	2.90	2.50
Buckwheat	8	85.10	89.10	87.40	8.60	11.00	10.00	2.20	2.40	2.25	62.60	65.40	64.50	7.80	9.40	8.70	2 00
Cotton seed, hulls and kernel	1	....	....	92.28	....	....	15.72	....	....	18.56	....	....	29.09	....	....	25.75	3.16

* Or albuminoids.

† Calculated to average water content.

COMPOSITION OF FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FRUITS, GRAINS AND OTHER SEEDS—*cont.*																	
Cow pea	5	79.20	89.99	85.21	19.30	23.00	20.77	1.30	1.60	1.43	48.10	61.99	55.75	3.37	5.00	4.06	3.20
Soja bean	3	89.87	93.95	91.41	34.63	38.62	36.22	16.80	19.00	17.92	26.20	30.50	28.66	3.69	5.00	4.24	4.37
Doura, brown (Durha)	3	87.30	92.40	89.00	9.00	11.50	10.30	....	....	4.20	....	....	69.90	....	....	1.50	1.60
Maize kernel (flint)	50	81.80	95.90	88.99	7.90	13.70	10.87	3.40	7.10	4.94	65.00	77.30	70.12	0.80	2.70	1.61	1.45
Maize kernel (dent)	26	84.80	93.80	88.80	8.10	11.80	10.50	3.80	6.30	4.70	66.30	75.30	70.20	1.30	3.00	1.80	1.50
Maize kernel (sweet)	14	89.10	94.00	91.20	10.20	14.40	12.20	5.30	9.30	8.00	62.70	72.40	66.90	1.50	4.90	2.30	1.90
Maize kernel ("Western corn")	3	79.30	83.60	80.90	7.80	8.60	8.30	3.60	3.90	3.70	64.90	68.20	66.00	1.70	1.80	1.75	1.20
Maize kernel, aver. of all varieties	100	79.30	95.90	88.89	7.80	15.30	10.81	3.40	9.30	5.31	61.80	77.30	69.47	0.90	4.90	1.80	1.50
Oats	21	86.50	91.10	89.30	8.00	14.40	11.30	4.10	5.80	5.00	57.10	66.90	61.00	1.50	12.90	9.00	3.00
Rice	10	86.00	88.60	87.60	5.90	8.60	7.40	0.30	0.60	.40	77.50	80.60	79.20	0.10	0.40	.20	0.40
Rye	6	86.80	91.30	88.40	9.50	12.10	10.60	1.40	2.10	1.70	70.70	73.90	72.60	1.40	2.10	1.60	1.90
Sorghum seed	13	83.20	90.70	87.24	7.70	12.66	9.12	2.10	4.60	3.71	66.80	73.60	70.57	1.50	3.20	2.03	1.81
Sorghum seed (decorticated), (see also sorghum meal below)	2	89.43	90.07	89.75	9.54	9.98	9.76	3.95	4.60	4.27	71.56	73.59	72.58	1.48	1.52	1.50	1.64
Wheat (winter)	58	86.20	92.50	88.80	8.40	14.50	11.70	1.30	2.70	1.90	68.10	81.70	71.80	1.20	1.90	1.70	1.70
Wheat (spring)	10	86.70	92.10	89.50	8.10	15.40	13.00	1.80	2.60	2.20	66.10	78.70	70.60	1.40	2.30	1.90	1.80
Wheat (average of all varieties)	99	86.20	92.50	88.96	8.10	15.94	12.21	1.20	2.99	2.15	66.10	77.70	71.08	1.10	2.30	1.66	1.86
Peanuts (without hulls)	2	93.20	93.80	93.50	....	....	28.30	41.20	51.50	46.40	....	....	1.80	....	....	13.90	3.30
Sword bean seed (*Canavalia gladiata*)	1	....	....	89.63	....	....	26.60	....	....	3.12	....	....	53.10	....	....	4.13	2.68
Chinese corn kernel	1	....	....	92.13	....	....	9.63	....	....	3.75	....	....	75.50	....	....	1.79	1.46
FLOUR AND MEAL.																	
Barley meal	3	83.80	86.00	84.90	8.80	13.90	11.80	0.70	2.20	1.70	...	....	70.90	....	....	.10	0.50
Buckwheat flour	3	85.10	87.20	86.50	4.20	8.00	6.50	0.70	1.70	1.30	75.80	79.40	77.30	0.20	0.40	.30	1.10

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* Or albuminoids.

COMPOSITION OF FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FLOUR AND MEAL—*continued.*																	
Graham flour	3	86.30	87.90	**86.90**	11.30	12.40	**11.70**	1.50	1.90	**1.70**	69.80	70.00	**69.80**	1.80	2.00	**1.90**	1.80
Hominy	2	86.40	86.60	**86.50**	8.10	8.40	**8.30**	0.40	0.50	**.50**	77.10	77.20	**77.15**	0.30	0.30	**.30**	0.40
Maize meal	13	78.30	90.14	**85.49**	7.40	13.94	**9.07**	2.50	4.63	**3.82**	60.72	72.70	**69.16**	0.90	2.99	**1.87**	1.57
Oat meal	6	91.10	93.70	**92.10**	12.90	16.30	**14.70**	6.10	8.80	**7.00**	66.60	69.00	**67.50**	0.60	1.20	**.90**	2.00
Rye flour	4	86.40	87.70	**86.90**	6.00	7.10	**6.70**	0.80	0.90	**.85**	77.60	79.10	**78.30**	0.40	0.50	**.45**	0.70
Wheat flour	49	86.50	91.70	**88.40**	8.60	13.50	**11.10**	0.60	2.00	**1.10**	68.30	78.50	**75.40**	0.10	1.20	**.20**	0.60
BY-PRODUCTS AND REFUSE.																	
Apple pomace	3	22.80	27.40	**25.90**	1.00	1.70	**1.40**	1.70	2.00	**1.90**	15.70	17.00	**16.70**	3.90	5.90	**5.20**	0.70
Brewers' grains, from brewery	8	21.50	31.40	**25.35**	4.70	7.80	**5.92**	0.80	2.90	**1.91**	10.10	15.94	**12.47**	3.10	5.60	**3.97**	1.06
Brewers' grains, from Silo	1	----	----	**33.20**	----	----	**6.90**	----	----	**2.60**	----	----	**16.90**	----	----	**5.40**	1.40
Brewers' grains, kiln dried	1	----	----	**97.40**	----	----	**20.40**	----	----	**6.40**	----	----	**54.90**	----	----	**11.80**	4.00
Brewers' swill	1	----	----	**5.70**	----	----	**1.90**	----	----	**.80**	----	---	**2.00**	----	----	**.70**	0.30
Cotton seed meal	14	90.90	94.32	**91.96**	38.69	50.81	**43.97**	11.29	18.00	**13.72**	12.70	25.19	**21.44**	3.10	11.80	**5.68**	7.15
"Hominy chops," "hominy feed," "Baltimore meal," "white meal"	5	86.50	93.20	**88.34**	9.50	10.20	**9.73**	4.45	10.20	**8.26**	61.00	71.10	**64.18**	3.20	4.80	**3.82**	2.35
Sorghum meal (from seed mostly decorticated)	1	----	----	**86.84**	----	----	**8.25**	----	----	**3.85**	----	----	**71.27**	----	----	**1.88**	1.59
Linseed cake	12	89.20	93.80	**90.96**	26.00	35.60	**29.70**	2.80	16.20	**11.25**	29.10	41.90	**35.03**	4.50	15.70	**8.54**	6.44
Linseed meal	3	87.57	92.87	**90.45**	30.88	33.95	**32.84**	4.94	6.83	**5.64**	36.54	41.11	**38.51**	7.12	8.87	**7.80**	5.66
Linseed meal ("new process")	3	87.10	90.10	**88.70**	32.00	37.60	**35.50**	2.70	5.90	**4.50**	----	----	**34.18**	-- -	----	**8.80**	5.80
Palm nut meal	2	89.16	93.86	**91.51**	13.63	16.01	**14.82**	6.41	18.73	**12.57**	33.80	41.66	**37.74**	21.57	23.98	**22.77**	3.61
Maize cob	9	85.60	92.80	**90.80**	1.20	2.70	**2.20**	0.10	0.90	**0.40**	45.30	59.60	**54.90**	29.80	38.30	**32.00**	1.30
Gluten meal	2	91.57	92.60	**92.13**	28.03	35.00	**31.51**	8.01	8.73	**8.37**	44.72	54.46	**49.60**	.73	3.25	**1.99**	.66
Malt sprouts	2	88.40	92.69	**90.55**	22.94	25.90	**23.92**	1.10	2.98	**2.04**	45.60	50.30	**47.86**	9.30	10.88	**10.09**	6.64

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* Or albuminoids.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.*			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
By-Products and Refuse—*continued.*																	
Rye bran	3	86.30	89.70	87.70	12.60	16.80	15.26	1.79	2.60	2.19	59.75	67.00	63.12	2.50	4.10	3.51	3.62
Sorghum bagasse	3	11.30	16.60	14.50	0.62	0.68	0.65	....	....	....	....	....	10.20	2.80	3.30	3.10	0.60
"Starch feed," refuse from starch manufacture	2	27.80	37.70	32.90	3.60	5.70	4.60	1.30	2.00	1.60	18.80	28.90	23.80	1.60	3.40	2.50	0.20
"Sugar feed," refuse from glucose manufacture (dry)	2	89.60	93.40	91.50	13.10	13.50	13.30	5.90	11.20	8.60	54.90	61.40	58.10	8.40	10.70	9.50	2.00
Glucose waste (wet)	1	....	....	24.00	....	....	3.72	....	....	1.63	....	....	17.39	....	....	.75	0.51
Vegetable ivory sawdust	1	....	....	81.20	....	....	3.40	....	....	.70	....	....	68.60	....	....	7.50	1.10
Wheat middlings	6	86.70	89.40	88.20	10.10	14.20	12.20	2.10	3.70	3.00	60.20	70.90	65.60	3.50	7.50	4.80	2.60
Wheat bran	15	86.10	91.35	88.24	7.80	16.88	14.88	2.60	5.84	3.90	50.41	58.90	55.07	5.90	16.60	8.70	5.69
Wheat shorts	5	87.80	89.00	88.50	11.10	15.10	13.00	2.50	4.90	4.00	56.30	62.30	59.70	6.30	10.50	7.70	4.10
Rice flour	1	....	....	89.68	....	....	14.00	....	....	13.49	....	....	51.22	....	....	6.12	4.85
Rice meal	1	....	....	84.90	....	....	9.30	....	....	1.60	....	....	59.90	....	....	8.10	6.00
Rice "Polish"	1	....	....	88.79	....	....	12.93	....	....	7.69	....	...	62.96	....	....	2.41	2.80
Rice feed	1	....	....	89.67	....	....	11.43	....	....	11.49	....	....	47.20	....	....	9.93	9.62
Rice bran	1	....	....	90.70	....	....	12.78	....	....	5.23	....	....	62.34	....	....	2.00	8.35
Rice bran "Douse"	1	....	....	91.22	....	....	10.93	....	....	8.20	....	....	41.93	....	....	17.76	12.40
Rice Hulls	2	91.50	92.30	91.90	3.12	4.68	3.90	0.55	0.65	.60	38.74	41.60	40.17	30.27	38.57	34.42	12.81
Rice straw	1	....	....	96.34	....	....	4.68	....	....	1.74	....	....	50.90	....	....	28.31	10.71

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* Or albuminoids.

SEED TESTS.

During the year 122 samples of seeds have been tested with regard to their vitality, and many of these tests have been repeated a number of times in experimenting with new forms of apparatus and in studying the effect of temperature on germination.

In this study attention has been chiefly directed to onion seed because its production is a long established business in this State, and the station is more often called upon to test this than any other kind of seed.

ONION SEED.

Within the last few years the Station has tested a considerable number of samples which were sent in by growers or wholesale dealers with information as to the variety of the seed, its age, and the locality where it was grown. These samples represented seed ready for market after winnowing and separating the small, light seed.

On the following pages are tabulated the results of those tests which were made on seed reputed to be less than one year old.

Numbers 130, 131, 138, 230, 253, 254, 255 and 258 are believed to have been more than one year old at the time of testing This is indicated by their low vitality and the fact that so large a percentage of seed remained hard at the end of the sprouting test. See Report of this Station for 1882, page 95.

Excluding these eight samples, the *vitality* of 72 samples is found to be on the average 81.8 per cent., ranging from 58.8 to 99.5 per cent., and the average weight of 79 samples, per 1000 seeds is 3.773 grams.

On only four varieties have a considerable number of tests been made. Their average vitality and weight are as follows:

Variety.	No. of tests.	Average vitality.	Average weight per 1000 seed (grams).
White Portugal	11	73.5	3.440
Wethersfield Large Red	16	80.9	3.758
Danvers Yellow	18	84.1	3.849
White Globe	10	84.0	3,836

The results of these tests show that the vitality of seed of the same variety and raised in the same geographical region

ONION SEED TESTS.

Variety.	Station No.	Where raised.	When raised.	Seed sprouted.	Seed remained hard (per ct.)	1-2 sprouted seed germinated in days.	1,000 seeds weigh (grams).
Wethersfield Large Red	**224**	R. I.	1882	86.8	4.5	5	3.793
“ “	**48**	Conn.	1879	92.5	7.0	4	3.910
“ “	**53**	“	1879	82.3	9.0	4	3.950
“ “	**131**	“	1880	75.3	18.5	4	4.284
“ “	**138**	“	1880	44.3	34.5	3	4.241
“ “	**225**	“	1882	75.8	4.5	5	3.754
“ “	**246**	“	1882	77.3	8.0	4	3.920
“ “	**247**	“	1882	73.0	17.5	4	4.217
“ “	**85**	Mich.	1880	74.0	13.0	4	3.966
“ “	**86**	“	1880	80.0	4.0	4	4.150
“ “	**132**	“	1880	85.3	5.5	4	4.373
“ “	**255**	“	1882	37.5	38.0		2.977
“ “	**117**	Cal.	1880	89.5	1.0	3–7	2.890
“ “	**181**	“	1882	79.5	2.0	5	2.869
“ “	**226**	“	1882	70.0	7.0	8–11	3.104
“ “	**46**	“	1878	92.5	4.5	5	3.737
Large Red Globe	**112**	Conn.	1879	90.5	5.0	4	3.797
“ “	**228**	“	1882	86.5	9.5	5	4.493
“ “	**249**	“	1882	85.5	7.0	4	4.189
“ “	**182**	Cal.	1882	89.0	3.7	6	3.285
Early Large Red Globe	**227**	“	1882	75.8	7.5	6	3.506
Early Red Globe	**84**	Conn.	1880	85.8	7.2	5	4.352
“ “	**229**	“	1882	72.6	13.0	6	4.004
“ “	**259**	Mich.	1882	58.7	14.5	6	3.039
Second Early Red	**235**	R. I.	1882	66.2	14.5	5	3.825
Extra Early Red	**244**	Conn.	1882	75.0	12.5	4	3.990
“ “	**245**	“	1882	69.0	15.0	4	4.010
“ “	**240**	Cal.	1882	89.3	1.5	4	3.362
Extra Early Flat Red	**80**	Conn.	1880	82.5	12.0	5	4.485
“ “	**223**	“	1882	74.0	9.0	5	4.220
“ “	**183**	Cal.	1882	96.3	2.0	4	3.612
“ “	**222**	“	1882	77.8	5.0	5	3.895
Extra Early	**170**	Conn.	1882	99.5	2.7	5	4.341
Danvers Yellow	**230**	R. I.	1882	35.3	30.0	5	3.347
“ “	**101**	Conn.	1880	92.2	5.5	5	4.179
“ “	**102**	“	1880	80.3	7.2	5	4.107
“ “	**109**	“	1880	85.2	7.7	5	4.172
“ “	**110**	“	1880	97.8	1.5	4	4.009

ONION SEED TESTS.

Variety.	Station No.	Where raised.	When raised.	Seed sprouted.	Seed remained hard (per ct.)	1-2 sprouted seed germinated in days.	1,000 seeds weigh (grams).
Danvers Yellow	136	Conn.	1880	88.5	6.5	4	4.333
" "	133	Mich.	1880	91.3	4.0	4	4.137
" "	258	"	1882	39.8	30.5	5	3.141
" "	58	N. Y.	1879	94.3	2.3	5	4.050
" "	97	"	1880	98.0	3.0	6	4.305
" "	98	"	1880	90.8	5.0	5	4.099
" "	134	"	1880	92.2	3.8	6	4.350
" "	135	"	1880	87.3	8.8	5	4.241
" "	49	"	1879	85.8	10.5	4	3.490
" "	55	"	1879	64.8	11.0	7	3.585
" "	118	Cal.	1880	88.5	0.8	4	2.662
" "	241	"	1882	74.8	4.0	5	3.052
" "	242	"	1882	78.0	9.5	4	3.990
Flat Danvers Yellow	231	N. Y.	1882	69.8	6.0	6	4.057
" "	180	Cal.	1880	94.5	0.8	5	2.981
" "	233	"	1882	82.3	1.0	6	3.169
Globe Danvers Yellow	179	"	1882	77.0	2.0	6	2.890
" "	232	"	1882	68.0	3.5	6	3.279
Yellow Dutch	111	Conn.	1880	80.0	4.8	5	3.350
"	253	Mich.	1882	57.3	23.0	6	3.014
White Portugal	50	Conn.	1879	75.8	14.0	3	3.720
"	114	"	1880	91.8	2.5	6	4.040
"	115	"	1880	88.0	7.0	5	4.190
"	116	"	1880	89.0	5.5	5	3.767
"	220	"	1882	60.0	3.5	5	3.788
"	131	N. Y.	1879	64.5	27.5	7	3.952
"	256	Mich.	1882	48.0	1.5	5	2.681
"	257	"	1882	69.5	14.0	6	3.254
"	178	Cal.	1882	73.8	2.8	5	2.605
"	221	"	1882	69.5	3.0	5	2.851
"	243	"	1882	70.0	2.5	6	3.000
White Globe	57	Conn.	1879	96.0	0.0	4	3.830
"	113	"	1880	93.8	2.0	4	4.444
"	218	"	1882	75.0	6.0	6	3.747
"	219	"	1882	70.8	7.0	6	3.946
"	250	"	1882	73.2	16.0	6	3.920
"	251	"	1882	88.7	8.0	5	4.260
"	129	N. Y.	1880	89.7	7.0	6	4.123
"	254	Mich.	1882	20.0	65.0	6	4.418
"	177	Cal.	1882	89.5	0.8	6	2.896
"	217	"	1882	77.0	0.5	6	3.258

varies considerably from year to year with the character of the season. For instance, the season of 1882 is said to have been an extremely bad one for raising seed in Michigan, and it is seen that the Michigan grown seed of that year is very light and sprouts poorly.

It is held by some growers that onion seed more than a year old raised in a favorable season gives a better crop than seed raised a year later in a poor season.

The average weight of 1000 onion seed, as found in 79 samples representing 14 "varieties" grown in different sections of the country, was 3.773 grams. The maximum weight was 4.493 grams; the minimum, 2.605 grams. From these figures we may compute the number of seeds per pound which is, in round numbers—

Average number of onion seed in the pound..............	12,000
Maximum number of onion seed in the pound..............	17,400
Minimum number of onion seed in the pound..............	10,000

The California grown onion seed seems to be smaller than eastern grown, and it has been found considerably lighter in all cases where it has been tested. To illustrate, the average weight of 1000 seeds of Wethersfield large red onion, Connecticut grown, in 16 trials was 3.95 grams; Michigan grown, 3 trials, 4.16 grams; California grown, 3 trials, 2.95 grams. White Portugal onion, Connecticut grown, 4 trials, 3.901 grams; California grown, 3 trials, 2.818 grams. Danvers yellow onion, Connecticut grown, 11 trials, 3.786 grams; New York grown, 5 trials, 4.236 grams; California grown, 3 trials, 3.234 grams, etc., etc.

The temperature most suitable for the germination of onion seed in laboratory tests has been made the subject of experiment. Haberlandt* has observed the germinating power of 56 species of seeds and the rapidity of their germination at 62°, 77°, 89°, 100°, 111°, 122° F., but onion seed was not among the number. In each trial made at this station three lots of two hundred seeds each were placed in three sprouting beds of the kind described below, and left to germinate at 51°, 60° and 85° F., respectively. These temperatures were not entirely constant, but the fluctuations were inconsiderable. A maximum and minimum thermometer stood with each apparatus, and the figures given are the average temperature. From time to time the seeds already sprouted were counted and removed.

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* Landwirthsch. Versuchs-Stationen xvii 104.

Following are the results:

Station No.	Variety.	Per cent. of seed sprouted at 51° F.	60°	85°
237	Italian	63.0	57.5	42.5
238	Italian	35.5	45.0	29.0
239	Italian	47.5	55.0	32.0
240	Extra Early Red	82.0	88.5	51.5
245	Extra Early Red	58.0	62.0	40.5
241	Yellow Danvers	78.5	83.0	45.0
242	Yellow Danvers	71.0	69.0	51.0
248	Yellow Danvers	64.5	82.5	29.0
243	White Portugal	65.0	69.0	39.0
246	Large Red Wethersfield	70.5	76.0	39.5
249	Large Red Globe	78.5	84.5	49.0
250	White Globe	77.0	77.0	50.5
251	White Globe	82.0	83.5	62.5
254	White Globe	20.5	15.5	10.0
253	Yellow Dutch	48.5	43.5	23.0
252	White Silver Skin (French)	67.0	73.0	47.0
	Average	**63.0**	**66.5**	**40.0**

It appears from these results that in every case fewer seeds germinated at 85° than at either of the lower temperatures. This difference is very decided in every instance except, perhaps, in No. 254, and amounts, on the average, to 25 per cent.

More seed germinated at 60° than at 51° in all the trials but one, No. 237. The differences, however, with the exception of No. 248, are seen to be comparatively small when it is considered that duplicate tests made at the same temperature not infrequently vary by 5 per cent.

One-half of the germinating seed sprouted within 10 days, on the average, from the beginning of the test at 51°; within 7 days at 60°, and 6 days at 85°.

The results demonstrate that a temperature not far from 60° F. is the most suitable for the germination of onion seed in the laboratory. Probably a difference of 5 degrees in either direction would make no essential difference in the results.

LETTUCE SEED.

The *vitality* of 28 samples of lettuce seed, representing 28 alleged "varieties," received from wholesale dealers, and stated by them to be fresh seed, winnowed and ready for market, was, on the average, 98.3 per cent. The maximum vitality was 100 per cent.; the minimum 93 per cent. Since there was so little difference in the vitality of the samples, the results of the tests are not here given in detail. The varieties were the following: Boston Curled, Extra Boston Curled, Early Boston Curled, Boston Market, Curled Simpson, black seed; Curled Simpson, white seed; Extra Curled Simpson, Early Simpson, Butter Salad, black seed; Butter Salad, white seed; Butter Salad, yellow seed; Tennis Ball, white seed; Early Tennis Ball, Hanson's, Large India, All the Year Round, Drum Head, Cabbage, or Malta Drum Head; White Paris, Frankfort Head, Early Curled Silesia, Ferry's Prize Head, Green Fringed, Philadelphia Butter.

The weight of 1000 seeds of the samples above referred to was on the average 1.28 grams. The maximum weight, 1.56 grams; the minimum, 1.00. Most of the samples were California grown.

Four samples of Early Boston Curled and two of White Paris are not included in the averages for this reason. The White Paris seed averaged .717 grams per 1000, and the four samples of Boston Curled .808 grams per 1000. These weights it will be seen are very much lower than the minimum of all the other 28 samples.

SEEDS FROM THE U. S. DEPARTMENT OF AGRICULTURE.

Twenty-five varieties of vegetable seeds distributed by the Department of Agriculture last winter have been tested with the following results:

Variety.	Station No.	Seed sprouted. Per cent.	Seed remained sound. Per cent.	1-2 sprouted seed germinated in days.
LETTUCE—				
Yellow Seeded Butter	184	99.0	2.0	3
Salamander	185	98.8	1.0	3
California Gardeners'	186	95.2	0.0	6
CABBAGE—				
Jersey Wakefield	187	98.8	0.0	5
Early Summer	188	96.2	3.5	5
Henderson's Early Summer	189	78.5	0.0	6
TURNIP—				
Purple Top Rutabaga	190	94.8	2.0	5
Sweet German Rutabaga	191	90.3	0.0	5
CARROT—				
Long Orange	192	53.0	30.5	6
Improved Long Orange	193	52.5	24.7	7
RADISH—				
Long Scarlet	194	71.7	0.0	4
White Tipped Scarlet Turnip	195	61.7	0.0	4
PEAS—				
Daniel O'Rourke	163	96.0	0.0	9
Challenge	164	94.0	0.0	9
Yorkshire Hero	165	95.0	0.0	9
Improved Daniel O'Rourke	166	94.0	0.0	8
SWEET CORN—				
Early Minnesota	168	60.5	0.0	13
Early Marblehead	169	83.5	0.0	14
ONION—				
Extra Early Onion	170	95.5	3.0	5
Extra Early Red	171	53.8	33.0	6
White Portugal	172	74.5	15.5	6
Red Globe	173	31.0	39.0	6
TOMATO—				
Trophy	175	45.5	?	5
Large Smooth	174	76.8	0.0	6
Acme	176	78.3	0.0	5

Most of them were of good quality as far as vitality is concerned. One sample of onion seed, 173, was evidently old and comparatively worthless. 31.0 per cent. sprouted, while 39 per cent. remained hard at the close of the test. One other sample, 171, is undoubtedly old seed.

It will be noticed that a laboratory test can only take into account three of the factors which determine the quality of a sample of seed, viz: its purity, that is, its freedom from seeds of other species of plants, its germinating power, and its weight.

At present it is not possible in most cases from such a test to decide whether the seed will produce vigorous or feeble plants, or whether it is true to name, in so far as to be free from all other varieties of the same species.

Apparatus for Testing the Vitality of Seeds.

During the year the apparatus here described has been tested and found to give perfectly satisfactory results with onion and lettuce seed. Other species of seeds have not as yet been tried in it.

The apparatus consists of a pan of copper or galvanized iron two and a half feet long, ten and a half inches wide and one and three-quarters inches deep. At one end is a small horizontal tube let into the side near the bottom, which may be closed with a cork. The pan has a slightly arched cover, two feet and four inches long, ten inches wide, with a rim three inches deep. It is provided with a handle and has two three-quarter inch orifices on top through which a thermometer can be introduced if desired, which also secures sufficient ventilation for small seed. The tiles which hold the seed to be tested are made of a very light* and coarsely-porous earthen ware which absorbs water almost as rapidly and abundantly as a sponge. This material is manufactured by S. L. Pewtress & Co., of New Haven, as a filtering medium, and is quite unlike any other earthenware that has come under our notice. Each tile is nine inches, by eight and one-half, by one and one-half. The upper surface is grooved, by help of a broad file, so as to form seven channels or beds, about one-quarter of an inch apart, running the length of the tile, each seven-eighths of an inch wide and three-sixteenths of an inch deep.

* One of them weighs, when dry, 2 pounds 11 ounces.

Each channel receives two hundred seeds, previously soaked for six to twelve hours, and a slip of paper with the proper label or number.

The water and seeds may be emptied together into the dry channel from the capsule in which they have been soaked and distributed evenly with the help of a wash bottle.

Each pan will carry three tiles or twenty-seven samples of seeds. The bottom of the pan is covered with water a quarter of an inch deep, the cover is put on and the apparatus placed where the temperature is tolerably constant and suitable for the germination of the seeds under trial.

The air in this apparatus is constantly saturated with moisture, the seed bed is also saturated but can never have water standing on it; the holes in the cover secure necessary ventilation, but the evaporation from the porous tiles is not so rapid as to reduce their temperature. These considerations and the fact that little care is necessary to keep the water supply constant, have led us to adopt this form of apparatus, after finding that the results of its use closely agreed with those obtained with moist filter paper as a sprouting medium. In sixty-six trials by the two methods a difference of ten per cent. or more occurred in four cases; the average difference was 0.7 per cent.

This sprouting apparatus thus appears to give unexceptionable results, and in convenience of use much surpasses any arrangement we have hitherto met with. For use with large seeds additional ventilation may be needful.

The Station's instructions for sampling seeds are as follows:

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

Instructions for Sampling Seeds.

The *Purity* and *Germinating Power* of Seeds intended for Farm and Garden use are learned by examining a small average sample. From a weighed amount of seed the pure seeds are culled out and weighed, foreign matters and especially noxious seeds are identified, the vitality of the pure seed is tested by careful sprouting trials, and a report is drawn up of the results.

As the test of germinating power requires some time for its completion, a report on samples sent in cannot be ordinarily expected in less than two weeks.

The examination of *grass-mixtures* can only be undertaken in special cases. It requires a large outlay of time and labor which is not often justified by the results.

In selecting a sample for examination the greatest care should be used to have it represent accurately the whole amount from which it was taken. This result will be secured by proceeding as follows:

1. Mix well together with the hand and arm the contents of the package (bag or barrel) or packages of seed.
2. Take out five or six small handfuls or cupfuls* from various parts of the package, mix these together and take a part of this mixture for the sample.
3. Send of the smaller seeds—red top, white clover, timothy, etc., two (2) ounces; of beets, turnips, red clover, etc., four (4) ounces; of wheat and cereals, and of peas and other legumes, eight (8) ounces.
4. Samples may be sent by mail, or otherwise, prepaid, and should be *plainly labelled* and addressed to

Conn. Agricultural Experiment Station,
New Haven, Conn.

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* A small cup may be closed with the palm of the hand, forced down to the desired place, then filled and withdrawn.

Seeds sent in for gratuitous examination must be accompanied by the following form:

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

Form for Description of Sample.

Station, No. Received at Station, 188 .

Each sample of seed sent for gratuitous examination must be accompanied by one of these Forms, with the blanks *below* filled out as fully as practicable.

This Form, filled out and sent with the sample, will serve as a label; but it should be returned *in good order* for filing in the Station Records.

Send with each sample a specimen of any printed circular, or statement that accompanies the seed or is used in its sale.

Name or label of seed,

Name and address of Producer or Importer,

Name and address of Dealer from whose stock this sample is taken,

Date of taking this Sample,

Selling price per pound or bushel,

Known or reputed age of seed,

Number of packages from which sample is taken,

Signature and P. O. address of person taking and sending the sample.

The results of the examination are reported to the party sending, on a Form, of which the following is an example:

REPORT OF SEED TEST.

CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

New Haven, Conn., 188 .

Examination of

Received 188 Station No.
From

Pure seed, per cent. by weight.
Impurities, per cent. by weight.
Pure seed sprouted during days. per cent. by number.
Pure seed decayed during days. per cent. by number.
Pure seed sound (unsprouted) after days. per cent. by number.
Of sprouted seed, ½ germinated in days.
1000 seeds weighed grams.
Per cent. value,

The "per cent. value" of a sample of seed is obtained by multiplying its per cent. (by weight) of pure seed into the per cent. (by number) found, or able, to germinate, and dividing by 100. It refers the number of seeds found, or able, to germinate, from "pure seed" back upon the sample itself, in terms of per cent. In case of *perennials only* it takes account of ⅓ of the unsprouted sound seeds, the proportion which, on an average of many observations, has been found to germinate under favorable conditions.

Director

MILK.

ANALYSES OF MILK OF AYRSHIRE COWS.

In March last, S. M. Wells, Esq., of Wethersfield, gave the station opportunity to make analyses of a number of samples of the milk of single Ayrshire cows from his well-known herd. The results are tabulated below. Two of the analyses are incomplete as respects some ingredients.

Name of Cow.	Mysie.	Mysie Athol.	Mysie McCrae.	Flora McArthur.	Flora 34
Water,	88.40	87.45	87.66	85.83	87,24
Casein and albumin,	3.03	3.07	3.26	....	3.05
Fat,	3.17	3.78	3.82	4.96	3.74
Sugar,	4.82	4.94	4.32	4.71	....
Ash,	.58	.76	.94	....	....
	100.00	100.00	100.00		
Total solids,	11.60	12.55	12.34	14.17	12.76
Date of dropping last calf,	Oct. 26, '82.	Feb. 27, '83.	Dec. 26, '81.	Mar. 21, '83.	Mar. 6, '83.

The milk was received Mar. 28, 1883. As will be seen, three of the cows were fresh in milk, one had been four months in milk and one fifteen months.

With perhaps the exception of the milk of Flora McArthur who calved only a week before the sample was taken, the analyses show as close agreement as could be expected between analyses of the milk of a single cow on different days, or at different stages of lactation. The average total solids amount to 12.76 per cent., which shows excellent quality.

CASE OF WATERED MILK.

In March, 1883, a sample of milk was brought to this station by the purchaser, who suspected adulteration. This suspicion was confirmed by the analysis I, see below.

It was reported to the sender that the milk might possibly be a genuine milk of extraordinary and abnormal composition, taken from a single cow; but in all probability it was rich milk (probably Jersey or Guernsey), which had been mixed with about one-third its weight of water. That to test the matter beyond all doubt a sample taken by a third party at the time of milking and known to be unwatered, might be sent for analysis; and if this trial should be refused the fact of watering would be rendered pretty certain.

A sample taken as suggested was soon afterwards analyzed with the following results, II:

	I.	II.
Specific gravity,	1.024	1.030
Solids, per cent.	10.04	14.14
Fat, "	3.31	5.48

The fact of watering thus proved was not denied, and the seller made the restitution demanded.

A sample of milk from the same party taken three weeks later contained 14.28 per cent. of solids and 4.40 per cent. of fat.

Examination of Market Milk.

Incidental to the proving of a method of determining fat in milk, partial analyses have been made of fifteen samples of milk bought at groceries or meat markets in New Haven in December, 1883. The price paid in all cases was four cents a pint. The results are as follow:

No.	Solids.	Fat.
48	9.25	2.81
49	13.03	4.19
50	10.32	2.95
51	11.32	3.46
52	13.03	3.79
53	9.77	2.99
54	11.41	3.71
55	13.55	4.49
56	11.06	3.00
57	12.52	3.99
58	12.04	3.94
59	13.88	5.38
60	12.61	4.33
61	14.26	5.66
62	12.77	4.15

Three of these samples, Nos. 48, 50 and 53 have probably been skimmed or watered, one other, No. 56, is of poor quality, the rest are, no doubt, pure milk. Nos. 59 and 61 are unusually rich.

These samples were not bought primarily with the object of finding out the quality of the milk kept on hand at the places visited, and they do not accurately show it. They show only what quality of milk a purchaser is likely to get. No pains are usually taken to stir the milk thoroughly in the can before dipping out, and it may easily happen that one customer will receive rich milk and another very poor milk from the same can.

Effect of Worry on the Quality of Milk.

On May 14, Mr. Wm. F. Morgan of Woodbridge, brought to the station a sample of milk from a cow recently purchased by him and turned in with his herd. The animal was represented to be a good milker, but the quality of her milk was inferior and no cream could be got from it. A partial analysis of the milk was made with the following results:

Specific gravity,	1.031
Solids, per cent.	11.28
Fat, "	2.16

The cow had been a pet and had not previously run in a herd. It was suggested by Mr. Morgan that she might be somewhat harrassed by the other cows. It is well known that excitement or "nervousness" often has an effect on the milk secretion and that the quality was thus strikingly influenced in this case is rendered highly probable by the following analyses of two samples of milk from the same cow, taken at later dates—which show excellent quality.

	Aug. 1, '83.	Jan. 15, '84.
Water, per cent.	87.50	84.92
Solids, per cent.	12.50	15.08
Casein and albumin, per cent.	2.81	3.34
Fat, per cent.	3.94	5.54

The present State law with regard to the sale of milk is as follows:

An Act to Prevent the Adulteration of Milk.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Whoever shall knowingly sell, supply, or bring to be manufactured to any butter or cheese manufactory in this State any milk diluted with water, or adulterated by the addition of any foreign substance, or from which any cream or milk commonly known as strippings has been taken; or whoever shall knowingly bring or supply milk to any butter or cheese manufactory that is tainted or partly sour, shall, for each offense, forfeit and pay a sum not less than twenty-five dollars nor more than one hundred dollars with cost of suit, to be sued for in a court of competent jurisdiction, for the benefit of the person or persons, firm or association, or corporation, or their assigns, upon whom such fraud shall be committed.

SEC. 2. The usual test for quality and the certificate of analysis of the director of the Connecticut Agricultural Experiment Station shall be deemed *prima facie* proof of adulteration.

SEC. 3. No person shall sell, or expose for sale any milk from which the cream or any part thereof has been removed, without distinctly and durably affixing a label, tag, or mark of metal in a conspicuous place upon the outside, and not more than six inches from the top of every can, vessel, or package containing such milk, and such metal label, tag, or mark shall have the words "Skimmed Milk" stamped, printed, or indented thereon in letters not less than one inch in height, and such milk shall only be sold or retailed out of a can, vessel or package so marked.

SEC. 4. No person shall sell or offer for sale, or shall have in possession with intent to sell or offer for sale, any impure or adulterated milk.

SEC. 5. Every person who shall violate the provisions of sections three and four of this act shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined not more than seven dollars, or be imprisoned not more than thirty days or both.

SEC. 6. A printed notice of this law shall be conspicuously posted in all public places, creameries, or factories where milk is received or sold.

Approved, April 25, 1882.

ON THE DETERMINATION OF NITROGEN BY COMBUSTION WITH CALCIUM HYDROXIDE.

In a paper by the Director, published in the American Chemist for 1873 (vol. III, p. 161), it was shown that the mixture of sodium hydroxide and calcium hydroxide or oxide, proposed by Will and Varrentrapp as a reagent for converting organic nitrogen into ammonia for the purposes of analysis may be advantageously replaced by a more easily prepared mixture of sodium carbonate and calcium hydroxide. When preparing that paper some combustions were made with simple calcium hydroxide and in case of uric acid for instance, the amount of nitrogen obtained fell short of the theoretical quantity by less than one per cent. As no entirely satisfactory results were then reached by burning with simple slaked lime, it was concluded that the presence of an alkali hydroxide, which it was thought might be formed in small quantity in the process of combustion, was necessary to the complete conversion of the nitrogen into ammonia. Further trials were then contemplated but not until recently has the opportunity offered to carry them out. A series of analyses whose results are here given, demonstrate that this further simplification of the Will and Varrentrapp method applies to all those classes of substances, which are ordinarily encountered in technical work.

The calcium hydroxide was prepared from a good quality of quick lime by slaking with water in but slight excess, drying off any surplus of water at a moderate heat, rubbing gently in a mortar, passing through a sieve of $\frac{1}{25}$ inch holes and bottling in well-closed "fruit jars."

The tubes were filled and the combustions were made in the way indicated in the Report of this Station for 1878, page 116. The points to be observed are chiefly these. For the burning of 0.5 gram of substances containing 8 per cent. of nitrogen or less, a tube of 14 inches is long enough. For dried blood or albuminoids containing from 12 to 17 per cent. of nitrogen a tube 2–4 inches longer is desirable.

The mixture of substance and slaked lime must not quite half fill the tube in length-wise direction. The long anterior layer of slaked lime must be brought to a *full red heat* before heating the mixture, and must be so kept throughout the combustion.

No fumes or tarry matters, indicative of incomplete combustion, should appear in the bulb containing standard acid.

When the combustion proper is begun it may be carried on quite rapidly until completed.

The tube is cooled below a red heat before aspirating.

The ammonia from the combustion is received in standard hydrochloric acid and titrated with a standard ammonia solution, using tincture of cochineal as an indicator.

The advantages of using cochineal tincture instead of litums solution are very considerable. It can be kept unaltered indefinitely, as litmus cannot, it is not seriously affected by the presence ot carbonic acid in solutions, and as an indicator it is more sensitive.

In our use of the mixture of slaked lime and sodium carbonate, the acid in the bulb-tube is frequently colored more or less deeply red. This in nowise interferes with the alkalimetry, for the red color fades as the point of neutralization is reached. In burning with simple slaked lime, the standard acid has almost invariably remained colorless, a fact which shows that the combustion with the latter is more perfect. Evidently it is highly heated water vapor which at once oxidizes the carbon and hydrogenizes the nitrogen, and the slaked lime alone, operates more effectually because it supplies more water in a given bulk of charge.

As was to be anticipated, the lime, at the full red heat to which it must be exposed, does not retain all the carbon dioxide that is formed; the gases which pass the standard acid give a copious precipitate in baryta-water. The standard acid, however, takes up from the heated gases too little carbon dioxide to sensibly affect the point of neutralization, and the entire accuracy of the determination is in no degree impaired.

The contents of the tube, after the combustion is finished, are mostly quicklime with some carbonate, since they slake strongly and effervesce slightly in dilute acid.

The following are some of the results obtained by the two methods. Soda lime here signifies the mixture of about equal bulks of sodium carbonate and slaked lime. The combustions have been executed by Mr. E. H. Farrington.

	Theory.	Soda-lime.	Slaked lime.
Crystallized potassium ferrocyanide,	19.93	19.82	19.86
Anhydrous " "	22.80	22.78	22.83
Potassium ferricyanide,	25.49	25.42	25.40
		25.46	25.42
Strychnine,	8.38		8.30
			8.32
Hippuric acid,	7.81	7.79	7.83
Dried oak leaves,	----	1.81	1.76
Dried chestnut leaves,	----	1.54	1.63
Wheat middlings,	----	2.28	2.30
Dried peat,	----	2.03	1.94
Castor pomace,	----	4.54	4.53
		2.48	2.39
"Fish and Potash,"	----	3.75	3.75
Superphosphate,	----	3.46	3.37
Bone,	----	3.93	4.02
"	----	6.70	6.61
Fish scrap,	----	7.16	7.12
" "	----	7.61	7.70
Dried blood,	----	11.79	11.88
		11.79	11.79
" "	----	11.18	11.26
		11.23	11.33

In the case of bone, fish and superphosphates, a still closer agreement would probably have been obtained by the two reagents if the materials analyzed had admitted of finer pulverization and more accurate sampling.

A considerably larger number of comparisons have been made, but in no case, except that of strychnine, was the difference greater than is indicated by the determinations above given.

The combustion of strychnine is more difficult than that of the other substances named above, and for good results it is needful to use it in small quantities, as seen from the subjoined statement.

			Soda-lime.	Slaked lime.
Strychnine,	0.5 grm.:	tube 12–14 in.	7.82	7.89
			7.85	7.98
"	0.3 "	" 14 "	7.44	
		" 20–22 "	8.14	8.14
			8.05	8.20
"	0.2 "	" 20 "	8.14*	8.25
"	0.1 "	" 20 "		8.30
				8.32

* Will & Varrentrapp's Soda-lime, made by Merck.

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STATE OF CONNECTICUT.

ANNUAL REPORT

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1885, Oct. 29.
Gift of
[illegible] Co,

OFFICERS

OF

The Connecticut Agricultural Experiment Station,

1884.

STATE BOARD OF CONTROL.

		Term expires
	Ex-officio.	
	HIS EXC. THOMAS M. WALLER, *President.*	
	Appointed by Connecticut State Agricultural Society:	
	HON. E. H. HYDE, Stafford, *Vice-President.*	July 1, 1885.
	Appointed by Board of Trustees of Wesleyan University:	
	PROF. W. O. ATWATER, Middletown.	1885.
	Appointed by Governor and Senate:	
	EDWIN HOYT, New Canaan.	1886.
	H. L. DUDLEY, New London.	1887.
	Appointed by Board of Agriculture:	
Executive Committee.	T. S. GOLD, West Cornwall.	1886.
	Appointed by Governing Board of Sheffield Scientific School:	
	W. H. BREWER, New Haven, *Secretary and Treasurer.*	1887.
	Ex-officio.	
	S. W. JOHNSON, New Haven, *Director.*	

Chemists.

E. H. JENKINS, PH.D., *Vice Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, JR., Ph.B.

In charge of Buildings and Grounds.
CHARLES J. RICE.

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, waters, milks, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on the various subjects of Agricultural Science, for the use and advantage of the Citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, &c., &c., for the Citizens of Connecticut, *without charge*, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 17.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be prepaid, and all communications should be directed, not to individual officers, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban St., between Whitney Avenue and Prospect St., 1⅝ miles North of City Hall. Suburban St. may be reached by Whitney Lake Horse Cars, which leave corner of Chapel and Church Sts. each hour and half hour.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State St., or from Peck & Bishop's Office in Union R. R. Depot.

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REPORT OF THE BOARD OF CONTROL.

To the General Assembly of the State of Connecticut:

The Board of Control of THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION herewith submits to your Honorable Body, the Annual Reports of the Director, the Treasurer, and Building Committee, made to the Board at its Annual Meeting at Hartford, January 20, 1885.

The buildings of the Station have been completed within the year, and the special appropriation made by the General Assembly in 1882, for the purpose of providing land and buildings for the Station, is expended. The report of the Building Committee gives the details regarding this expenditure. There has been no interruption in the work of the Station during the year.

The provisions of the new Fertilizer law have increased the income of the Station, and very materially increased its work in the direction of fertilizer analyses, their collection and oversight, and the correspondence incident to requirements of the law. As a knowledge of the Station and its work becomes more generally diffused among the people, there is a continually increasing demand for such help as the Station can give, and the sphere of its usefulness is enlarging from year to year.

By special resolution, the General Assembly has in preceding years ordered the printing of extra copies of this report, a large share of which have been distributed in advance of the regular edition. Such copies have cost less than ten cents each, and the demand for them makes similar action desirable this year.

HENRY B. HARRISON,
President.

WM. H. BREWER,
Secretary.

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with the Connecticut Agricultural Experiment Station.*

Receipts.

Balance from account of 1883	$3.44	
Analysis fees	3,845.00	
State Treasurer, Annual Appropriation	8,000.00	
Miscellaneous receipts	3.88	
		$11,852.32

Payments.

Salaries	$6,625.54	
Laboratory and Experiments	771.47	
Repairs and improvements on Laboratory and House	1,052.21	
The Grounds and Establishment	579.81	
Fuel	287.00	
Gas	285.34	
Water	132.00	
Insurance	54.00	
Collecting Fertilizers	88.83	
Traveling Expenses of the Board	38.20	
Printing	349.95	
Stationery	27.67	
Postage	139.79	
Telephone	100.10	
Library	292.35	
Miscellaneous Sundries	194.28	
Balance on hand	833.78	
		$11,852.32

There is due the Station $110 on analysis fees. The above account is for the State fiscal year ending November 30, 1884. The report of expenditures from the special appropriation for buying a lot and erecting buildings for the Station, may be found in the report of the building committee (see page 121).

WM. H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

The work of this Station has gone on without interruption since the time covered by the last report.

As usual, the analysis of fertilizers and fertilizing materials has occupied its working force through the greater part of the year, in order to meet the increased demand for such work. One hundred and seventeen different brands of fertilizers have been legally offered for sale in the State during the year, an increase of twenty-four over the preceding year. As required by law, one or more analyses of each of these brands has been made and published, except in the few cases where the goods were not found on sale in the State by the agents of the Station, and at the same time the manufacturer had failed to comply with the provision of the law, which requires that a sealed sample shall be deposited with the director of the Station. A considerable number of home-made fertilizers and waste products, used as manure, have also been examined, making the total number of fertilizer analyses two hundred and seventy-two, an increase of fifty-three over last year.

Twelve samples of feeding stuff have been analyzed, and in connection with this work all the analyses of American feeding stuffs published in this country during the year, which were accessible, have been incorporated in a table, giving the average composition of one hundred different materials, which will be found in the following pages.

Forty-five samples of seeds have been tested in the laboratory and garden.

Fifteen samples of milk have been examined, partly on behalf of creameries, partly with reference to the quality of the milk supply of our towns. Details are not necessary. The milk was good in every case.

Analyses of the ash of eight samples of tobacco and of one sample of tobacco stalks are given and discussed on subsequent pages.

Besides the above a large amount of work has been done which cannot well be classified or here recorded, in answer to the questions of correspondents, in testing analytical methods, in controlling the accuracy of the laboratory work, etc.

The Bulletins of the Station have been five in number, issued in April, May, July, September and October, making up in all sixty-two printed pages. The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible. During the year the demand for them has considerably increased.

As required by law, a package of each Bulletin is mailed to every post-office in the State. The package is directed to the postmaster, with a request to distribute to farmers.

The Bulletins are also regularly sent to every newspaper in the State and to the Secretary of each Agricultural society and Farmers' club.

The Bulletins will be regularly sent, also, on application, to any address in Connecticut.

To citizens of other States remitting fifty cents, the publications of the current year, including Bulletins and Annual Report, will be mailed as they appear.

The clerical work of the Station has included the writing of over nine hundred letters, besides one or more reports on each fertilizer and fodder analyzed, and the work incident to the compilation of the Bulletins and Reports.

THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a new Fertilizer Law, which went into effect September 1, 1882, and which repeals and takes the place of all previous legislation on this subject in this State.

Since a full understanding of the provisions and penalties of this law is important to all parties who buy or sell commercial fertilizers, attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a *certified statement* of composition. net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a *sealed sample* shall be deposited with him by the MANUFACTURER OR IMPORTER. Section 2.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

4. All "CHEMICALS" that are applied to land, such as : Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Lime (Gypsum or Land Plaster), Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 9 of the Act.

Here follows the full text of the law, with explanatory foot-notes.

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

GENERAL ASSEMBLY,
January Session, A. D. 1882.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Printed statement to be affixed to all packages and to go with all lots.

SECTION 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

Before sale *certified copies* of statement, and *Sealed Sample* to be deposited with Director.

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said

director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

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* A statement of the per cents. of Nitrogen, Phosphoric Acid (P_2O_5) and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric Acid.

For Potash Salts give always the per cent. of Potash (potassium oxide); that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

Analysis Fee to be paid annually on or before May 1st.

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

Yearly Report to Station of Dealers or Agents.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

Leather.

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

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* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

On receipt of statements, samples and analysis-fees, the Station will issue Certificates of Compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

Fish-guano, &c.

SEC. 6. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

Fines.

SEC. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

Fertilizers for private use.

SEC. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

Director's duties and authority.

SEC. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the station, and shall cause one or more analysis of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

Bulletins.

SEC. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

Repeal of former acts.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed.

SEC. 12. This act shall take effect on the first day of September, 1882.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in section 9, that all fertilizers be analyzed and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

OBSERVANCE OF THE FERTILIZER LAW.

In the following list are given the names of those parties who have paid the analysis fees as required by the Fertilizer Law, and the brands on which analysis fees have been paid for the year ending April 30th, 1885.

Firm.	*Brand of Fertilizer.*
Anderson, W. H., Putnam, Conn.	Ground Bone.
Baker, H. J. & Bro., 215 Pearl St., New York.	Castor Pomace.
	"A. A." Ammoniated Superphosphate.
	Pelican Bone Phosphate.
	Special Corn Fertilizer.
	" Potato Fertilizer.
	" Oat Manure.
	" Tobacco Manure.
	" Grass "
Bennett, P. W., Rockfall, Conn.	Ground Bone.
Bosworth Bros., Putnam, Conn.	Superphosphate of Lime.
	Potato Phosphate.
	Ground Bone.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Grain Manure.
	" Forage Crop Manure.
	" Vegetable Manure.
	Bowker's Hill and Drill Phosphate.
	" Fish and Potash.
	" Dissolved Bone.
	" Dry Fish.
	" Kainit.
Bradley Fertilizer Co, 27 Kilby St., Boston, Mass.	Bradley's Superphosphate.
	B. D. Sea-Fowl Guano.
	Original Coe's Superphosphate.
	Circle Brand Bone.
Brown, R. B., Oil Co., St. Louis, Mo.	I. X. L. Castor Pomace.
Coe. E. Frank, 16 Burling Slip, New York.	Ammoniated Bone Superphosphate.
	Alkaline Bone.
	Ground Bone.
Coe, Russel, Linden, N. J.	Ammoniated Bone Superphosphate.
	Fish and Potash.
	Special Favorite.
	Potato Manure.
Clark's Cove Guano Co., New Bedford, Mass.	Great Planet "A."
	Bay State Fertilizer.
Collier White Lead & Oil Co.. St. Louis. Mo.. by F. Ellsworth, Hartford.	Castor Pomace.
Common Sense Fertilizer Mfg. Co., 42 Congress St., Boston, Mass.	Common Sense Fertilizer. No. 2.
Peter Cooper's Glue Factory, 17 Burling Slip, New York.	Bone Dust.
Crocker. L. L., Buffalo Fertilizer and Chemical Works, Buffalo, N. Y.	Ammoniated Bone Superphosphate.
	Potato. Hop and Tobacco Phosphate.
	Superphosphate, No. 2.
Curtis, J. G., Elliott, Conn.	Reliable Superphosphate.
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Animal Fertilizer.
	Ground Bone.
Dickinson, David, Middle Haddam, Conn.	Superphosphate of Lime.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.

Firm.	*Brand of Fertilizer.*
W. Burr Hall, Wallingford, Conn.	Ground Bone.
	Meat and Plaster.
Harris, Geo. H. & Son, Eagleville, Conn.	Pure Ground Bone.
	" Bone Phosphate.
Hurtado & Co., 16 and 18 Exchange Place, New York.	Peruvian Guano, Lobos.
	" " Guaranteed.
	" " Standard.
Judson & Sparrow, 38 South Market St., Boston, Mass.	Bone and Potash Phosphate.
Lister Brothers, Newark, N. J.	Standard Ammoniated Dissolved Bone.
	Special Potato Fertilizer.
	" Corn "
	Ground Bone.
	Standard Superphosphate.
Lombard & Mathewson, Warrenville, Conn.	Superphosphate.
	Ground Bone.
McNamara, M., Trumbull, Conn.	Ground Bone.
Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	The Mapes' Potato Manure.
	" Corn "
	" Complete " for Light Soil.
	" Tobacco " Conn. Brand.
	" Tobacco " for use with stems.
	" Grass and Grain, Spring Top Dressing.
	The Mapes' Complete Manure, "A" Brand.
	Plain Superphosphate, High Grade.
	Nitrate of Soda.
	Muriate of Potash.
G. W. Miles Co., Milford, Conn.	I. X. L. Bone Superphosphate.
	Fish and Potash Fertilizer.
Miller, G. W., Middlefield, Conn.	Raw Bone Phosphate.
	Ground Bone.
Mitchell, A., Linden, N. J.	Standard Superphosphate.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizer for Roots.
	Chittenden's Complete Fertilizer for Grain.
	Chittenden's Complete Fertilizer for Tobacco.
	Chittenden's Fish and Potash.
	" Ammoniated Bone Superphosphate.
	Cooke's Blood Guano.
	" Dissolved Ground Bone.
New Haven Fertilizer Co., New Haven, Conn.	Standard Ammoniated Superphosphate.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Preston Fertilizer Co., Greenpoint, L. I.	Fish Guano.
	Ammoniated Superphosphate.
	Ground Bone.
Quinnipiac Fertilizer Co., New London, Conn.	Quinnipiac Phosphate.
	" Extra Phosphate.
	Dry Ground Fish.
	Fish and Potash, Crossed-fishes Brand.
	" " Plain Brand.
Read & Co., New York.	Matchless Tobacco Manure.
	Farmers' Friend Fertilizer.

Firm	*Brand of Fertilizer.*
Rogers & Hubbard Co., Middletown, Conn.	Pure Raw Knuckle Bone "A."
	" " "Meal."
	Ground Bone "A. X."
	Bone Sawdust.
Sanford, Charles, Redding Ridge, Conn.	Bone Superphosphate.
Shoemaker, M. L. & Co.. Philadelphia, Pa., by F. Ellsworth, Hartford.	Swift Sure Superphosphate.
	" Bone Meal.
Slade, F. C., Oakville, Conn.	Ground Bone.
Smith, Edmund, South Canterbury, Conn.	Ground Bone.
Stearns & Co., 149 Front St., New York.	Eagle Brand Fish and Potash.
	Dry Ground Fish.
	Ammoniated Bone Superphosphate.
St. Louis Lead and Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford.	Castor Pomace.
Thomson, Paul, Hartford, Conn.	Charter Oak Fertilizer.
Williams, Clark & Co., 101 Pearl St., New York.	Americus Superphosphate.
	Fish and Potash.
	Acorn Brand Kainite.
	" Muriate Potash.
Wilcox, L. & Co., Mystic Bridge, Conn.	Wilcox Prepared Fertilizer.
	Acidulated Fish Guano, Ground.
	Dry Ground Fish Guano.

ANALYSES OF FERTILIZERS.*

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials : the first for the benefit of farmers, gardeners, and the public generally ; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that will work against the public good.

During 1884, two hundred and seventy-two (272) samples of fertilizers have been analyzed. Of these, 59 were examined for private parties, and the remainder for the general use of the citizens of the State.

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*The matter of this and several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied, with a few appropriate alterations, from the Report for 1883. This repetition appears to be necessary for the use of readers who have not seen former Reports.

Sixty-two samples analyzed for the public benefit have been sent in by purchasers and consumers. The rest have been supplied by agents of the Station who during the spring and early summer endeavored to visit all sections of the State, to take one or more samples from every brand of fertilizer offered for sale in the State, and to take them from the stock of dealers in remote places as well as from centers of trade.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one, by means of a sampling tube, which withdraws a section or core through the entire length of the package.

The greatest care is necessary in sampling fertilizers that the small sample taken shall accurately represent the whole stock from which it is drawn. Otherwise serious injustice may be done.

During the year the Station has had to reject a number of samples sent in for analysis by purchasers on account of evident carelessness in drawing them.

The Station none the less desires the coöperation of farmers and Farmers' clubs in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All such samples are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION.

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

The *valuation* of a high-priced Fertilizer requires the amounts *per cent.* of its principal fertilizing elements to be known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit-can or tin box, holding about *one quart*, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

THE CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

The foregoing instructions may be over-nice in some cases, but they are not intended to take the place of good sense on the part of those who are interested in learning the true composition of a fertilizer. Any method of operating that will yield a *fair sample* is good enough.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin-tube, like a dipper handle, put well down into the packages, in a good number of places, will give a fair sample with great ease. With dry, coarse articles, such as ground bone, there is liable to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling. Otherwise the analysis will certainly misrepresent the article whose value it is intended to fix.

The quantity sent should not be too small. When the material is fine and uniform, and has been carefully sampled, a pint may be enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the sample should not be *less than one quart.*

It is also important that samples for analysis should be taken at the time when the fertilizer is purchased, and immediately dispatched to the Station. Moist fish, blood or cotton seed meal will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

These changes in the composition of a sample not suitably preserved must invalidate any conclusions from its analysis, and work serious injustice either to the manufacturer or to the consumer.

It doubtless often happens that a purchaser on laying in a stock of fertilizers decides that he will not then trouble the Station to analyze the goods he has obtained, but will set aside samples which he can send for examination in case the crops report adversely as to their quality. It is always better to send all samples at once to the Station, where they can be directly analyzed or so prepared that they will keep without chemical change.

With the Instructions for Sampling, the Station furnishes a blank form for Description of Sample, a copy of which is here given.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

New Haven, Conn.

Form for Description of Sample.

Station No............Rec'd at Station,..................18

Each sample of Fertilizer sent for gratuitous analysis must be accompanied by one of these Forms, with the blanks *below* filled out fully and legibly.

The filled out Form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

Brand of Fertilizer,.......................................

Name and address of Manufacturer,..........................

....

Name and address of Dealer from whose stock this sample is taken,...

Date of taking this sample,................................

Selling price per ton or hundred, bag or barrel,...........

Selling weight claimed for each package weighed,...........

Actual weight of packages opened,..........................

Here write a copy of any analysis or guaranteed composition that is fixed to the packages.

....

Signature and P. O. address of person taking and sending the sample.

....

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description" which accompanies it is filed in the Station's Record of Analyses, and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least, under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description," when properly filled out, also, contains all the data of cost, weight, etc., of a fertilizer which are necessary for making, with help of the analysis, a valuation of its fertilizing elements, and estimating the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the description may work injustice to the manufacturers or dealers, as well as mislead consumers. It is especially important that the *brand* of a fertilizer and its *selling price* shall be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated, and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for explanation or protest, if desirable, before the results are published in the Bulletin.

With the analysis there is sent to the party furnishing the sample a printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages, and are, therefore, reproduced here, as follows:

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

REVISED.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *Phosphoric acid* means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and reverted phosphoric acid are on the whole about equally valuable as plant-food and of nearly equal commercial value. In some cases, indeed, the soluble gives better results on crops, in others the reverted is superior. In most instances there is probably little to choose between them.

Insoluble Phosphoric acid implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada Apatite. Bone black, bone-ash, South Carolina Rock and Navassa Phosphate when in coarse powder are commonly of little repute as fertilizers though good results are occasionally reported from their use. When *very finely pulverized* ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones, which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It should be soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this Station, signifies finding *the worth in money or trade-value, of its fertilizing ingredients.* This value, it should be remembered, is *not necessarily proportional to its fertilizing effects* in any special case.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $60 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade Value of the above-named Ingredients*, a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

The average Trade-values or cost in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as recently found in the New England, New York and New Jersey markets, are as follows :—

These Trade-values have been agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several states.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1884.

	Cents per lb.
Nitrogen in ammonia salts,	22
" in nitrates,	18
Organic nitrogen in dried and fine ground fish,	20
" " in guanos, dried and fine ground blood and meat,	18
" " in cotton seed, linseed meal and in castor pomace,	18
" " in fine ground bone,	18
" " in fine medium bone,	16
" " in medium bone,	14
" " in coarse medium bone.	12
" " in coarse bone, horn shavings, hair and fish scrap,	10
Phosphoric acid, soluble in water,	10
" " soluble in ammonium citrate,*	9
" " insoluble, in dry fine ground fish and in fine bone,	6
" " " in fine medium bone,	5½
" " " in medium bone,	5
" " " in coarse medium bone,	4½
" " " in coarse bone,	4
" " " in fine ground rock phosphate,	2½
Potash as high grade sulphate,	7½
" kainite,	4½
" muriate,	4½

The above trade-values are the figures at which on March 1st the respective ingredients could be bought at retail for cash, in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the *reasonable retail price* in case of standard raw materials such as :—

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* Dissolved from 2 grams of the unground Phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 40° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Plain Superphosphate.
Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bone,
Ground So. Car. Rock.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES, AND MIXED FERTILIZERS OF HIGH GRADES.

The Organic Nitrogen in these classes of goods will be reckoned at the highest figure laid down in the Trade-Values of Fertilizing Ingredients in Raw Materials, namely, 20 cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, blood, animal matter, Peruvian guano or other equally good form and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric acid will be reckoned at 4½ cents, it being assumed that it is from bone or similar source and not from rock phosphate, unless found otherwise. In this latter form the insoluble phosphoric acid would be worth commercially only 2¼ cents per pound or but one-half as much as if from fine bone. Potash will be rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash is reckoned as sulphate.

In most cases the valuation of the Ingredients in Superphosphates and Specials will fall considerably below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents or dealers, long credits, interest on investment, bad debts, and finally, profits.

In 1883, the selling price of superphosphates and specials in Connecticut was, on the average, 18 per cent. greater than the Station valuations, or 38 per cent. in advance of the wholesale cost of the fertilizing elements in the raw materials.

The average cost of Ammoniated Superphosphates and Guanos was about $41.50, the average valuation was $35, and the difference $6.50—an advance of 18.6 per cent. on the valuation.

In case of Specials the average cost was $50, the average valuation, $42.50, and the difference $7.50, or 17.6 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 1st, 1883 to November 1st, 1884, were as follows:

Phosphate Rock,	6
Phosphatic Guanos,	3
Bone Black,	1
Bone Ash,	2
"Phosphoral,"	1
Superphosphates, (plain)	24
Superphosphates [ammoniated] and Guanos,	105
Superphosphates and other fertilizers, home made,	7
Special Manures,	24
Bone Manures,	35
Dry Ground Fish,	11
Blood and Tankage,	2
Nitrates,	5

Sulphate of Ammonia,	3
Cotton Seed, Linseed, and Castor Pomace,	6
Meat and Plaster,	1
Potash Salts,	11
Cotton Hull Ashes,	6
House Ashes,	2
Brick-kiln Ashes,	1
Hen Manure,	1
Elephants' Dung,	1
Damaged Grain,	1
Paper Mill Waste,	1
Marine Mud,	1
Swamp Muck or Peat,	2
Marl,	1
Sewage Filters,	2
Plaster,	2
"Fertilizer,"	1
Pollard's Fertilizers	4
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Of these, 59 were samples analyzed for private parties and are not further noticed in these pages. The remaining analyses are given in detail with such discussion as may make them more serviceable.

PHOSPHATE ROCK.

Of the six samples analyzed, three were from small lots used in laboratory experiments.

The other three were as follows:

1245. Crude Fine Ground Navassa Rock.

1262. Crude Fine Ground Navassa Rock.

1263. Crude Fine Ground Red Navassa.

They were purchased of John Reed, 12 Cliff Street, N. Y., and sampled and sent by J. M. Milbank, Greenfield Hill.

ANALYSES.

	1245	1262	1263
Total phosphoric acid	16.69	16.86	25.01
Of which, soluble in ammonium citrate at 40°		1.13	1.08
" " " " " 65°		1.61	1.66
Cost per ton,	$17.00	$17.00	$14.00
Phosphoric acid cost per 100 lbs.,	5.09	5.04	2.79

All the samples had a reddish brown color, **1263** being much darker than the others. The material was fine, passing easily $\frac{1}{50}$ inch mesh, and contained carbonates in considerable quantity. A sample of the same brand of goods from the same firm, analyzed last year showed 29.90 per cent. of phosphoric acid.

The price and quality of **1245** and **1262** make them much less desirable than **1263,** which furnishes phosphoric acid, in as available a form presumably, for little more than half the price.

The raw phosphates, South Carolina and Navassa, and the phosphatic guanos have been used by some of our farmers instead of superphosphates with satisfactory results. While on the one hand the acid phosphates are more quickly available, on the other hand much more phosphoric acid can be applied to land for the same money in the form of raw phosphate, which latter advantage may make the raw material *in some cases* the more economical as in seeding down to grass or preparing land for fruit trees. In the seven plain superphosphates described further on, phosphoric acid has cost about $8.50 per 100 lbs. If it can be bought in raw phosphate at $3.00 per 100 lbs., then 283 lbs. of phosphoric acid can be applied in raw phosphate at the same cost as 100 lbs. in acid phosphate.

PHOSPHATIC GUANO.

1091. Penguin Island Guano. Stock of Charles Spear, Jr., 85 West street, N. Y. Sampled and sent by C. H. Cables, Thomaston.

ANALYSIS.

Phosphoric acid soluble in ammonium citrate,	6.41
Phosphoric acid insoluble in ammonium citrate,	16.49
Nitrogen,	.20

The cost of this article was $25.00 in New York. Reckoning the so-called reverted phosphoric acid* at 9 cents, the insoluble phosphoric acid at 4½ cents, and the nitrogen at 20 cents per pound, the valuation of this guano would be $27.17.

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* For the meaning of "phosphoric acid in soluble ammonium citrate," otherwise called "reverted phosphoric acid," see Explanations, p. 23.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

In the following table (page 33) are given the analyses and valuations of ten samples which have general interest.

Two samples **1190** and **1170** are made from the spent bone black of sugar refineries. They are almost identical in composition and practically all of the phosphoric acid which they contain (over 17 per cent.), is soluble in water.

1165 and **1172** are called Dissolved Bone. **1172** contains .25 per cent. of nitrogen, which proves the presence of a small amount of organic matter in the goods, presumably from bone. Such superphosphates are prepared from bone which has been boiled or steamed for the extraction of animal matters in the glue factories. This process leaves it dry and brittle without grease and with little nitrogenous matter to interfere with the action of an acid. When raw bone is treated with acid theoretically sufficient to make the phosphoric acid soluble, the grease, animal matter and acid together form a smeary sticky mass, which cannot be handled or spread. Not more than one-third of the phosphoric acid of raw bones can be dissolved with acid practically, without making the product too sticky for convenience.

It should be said that **1172** was sold at a reduced price by the manufacturer, being an odd lot not of the usual composition.

It furnishes however, about 17 per cent. of available phosphoric acid at a low price.

1134 is a sample drawn from a bag of superphosphate, given to this Station by the North Carolina Department of Agriculture, which was made from the phosphate rock lately discovered in that State. It contains as much soluble phosphoric acid as a good deal of the acid phosphate made from South Carolina rock, but less reverted and insoluble phosphoric acid. The development of the North Carolina phosphate deposits as well as those of Alabama, will be watched with interest. As yet their products have not entered the market.

Allowing 9 cents per pound for reverted phosphoric acid, and 2¼ cents per pound for insoluble phosphoric acid, the soluble phosphoric acid in these goods has cost from 7½ to 10½ cents per pound, or on the average 9⅛ cents.

Making no allowance for the reverted or insoluble acid, soluble phosphoric acid has cost from 7½ to 11½ cents per pound, or, on the average 10¼ cents.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1190	Dissolved Bone Black.	Geo. B. Forrester, N. Y. City.	Manufacturer.	M. S. Baldwin, Naugatuck.
1172	Pure Dissolved Bone.	H. J. Baker & Bros., N. Y. City.	"	J. J. Webb, Hamden.
1180	Mapes' High Grade Superphosphate.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N.Y.	-----	Station Agent.
1256	Plain Superphosphate.	Nat. Fertilizer Co., Bridgeport.	Manufacturer.	R. A. Moore, Kensington.
1243	Navassa Superphosphate.	John Reed, 12 Cliff St., N. Y.	-----	J. M. Milbank, Greenfield Hill.
1184	Bowker's Acid Phosphate.	Bowker Fertilizer Co., Boston and New York.	Usher & Tinker, Plainville.	Station Agent.
1170	Bradley's Dissolved Bone Black.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Manufacturer.	C. H. Cables, Thomaston.
1165	Baker's Pure Dissolved Bone.	H. J. Baker & Bros., 215 Pearl St.. New York.	D. H. Van Hoosear, Wilton.	D. H. Van Hoosear, Wilton.
1134	North Carolina Acid Phosphate.	-----	-----	N. C. Dep't Agriculture.
1331	Acid Navassa Phosphate.	John Reed, 55 Cliff St., New York.	-----	From bag purchased by Station.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

Station No.	Name or Brand.	Phosphoric Acid.							Cost per Ton.	Valuation per Ton.	Valuation Exceeds Cost.
		Soluble.	Reverted.	Insoluble.	Total Phos. Acid.	Phos. Acid Guaranteed.	Available.				
							Found.	Guaranteed.			
1190	Forrester's Dissolved Bone Black	17.29	.00	.11	17.40	....	....	....	$26.00	$34.63	$8.63
1172	Baker's Pure Dissolved Bone	9.82	7.11	3.93	20 86	....	....	....	28.00	35.97	7.97
1180	Mapes' High Grade Superphosphate	32.64	1.38	.64	34.66	....	....	....	65.00	68.34	3.34
1256	Chittenden's Plain Superphosphate	8.04	1.66	3.48	13.18	....	....	....	18.00	20.64	2.64
1248	Navassa Superphosphate	10.97	.52	2.67	14.16	....	....	....	23.00	24.08	1.08
1184	Bowker's Acid Phosphate	10.82	1.11	3.13	15.06	....	....	....	25.00	25.05	.05
1170	Bradley's Dissolved Bone Black	17.13	.00	.09	17.22	....	....	....	34.50	34.30	Cost Exceeds Valuation. $0.20
1165	Baker's Pure Dissolved Bone	13.91	.24	.35	14.50	....	....	....	30.00	28.57	1.43
1184	North Carolina Acid Phosphate	10.85	.52	.47	11.84	....	....	....	....	...	....
1881	Acid Navassa Phosphate	....	....	....	....	....	....	....	....	....	....

NITROGENOUS SUPERPHOSPHATES, FISH AND POTASH AND GUANOS.

(See pages 37 to 44.)

In this class are included all superphosphates containing nitrogen, (which with a few exceptions also contain potash), except such as are claimed to be specially adapted to the wants of some particular crop or class of crops; also Peruvian guano, crude or manipulated, and the fish fertilizers which have been treated with acid or mixed with potash salts. The analyses of dry ground fish are tabulated by themselves further on.

Of the nitrogenous superphosphates here described 4 are guanos, 26 are called "Superphosphates" or "Ammoniated Superphosphates," 8 "Fish and Potash," 6 "Dissolved Bone," 2 "Complete Manures," 2 "Animal Fertilizers," and the rest are "Acid Fish Guano," "Sea Fowl Guano," "Soluble Pacific Guano," "Blood Guano," "Pelican Bone," "Prepared Fertilizer," "Swift-Sure Phosphate," "Reliable Phosphate," "Special Favorite," "Common Sense Fertilizer," "Bone and Potash Phosphate."

Samples **1320, 1313, 1198, 1316, 1311, 1314, 1317** and **1329** are "Manufacturers' Samples," deposited by the manufacturers with the director of the station in compliance with Section 2 of the fertilizer law. The station agents who visited different parts of the state to draw samples did not find those brands for sale at any of the points visited. It therefore became necessary for the station, in order to do its part under the provisions of the law, to analyze these samples, although as a rule it prefers to analyze only those goods which are procured from stock offered for sale in the state.

1254. Miller's Raw Bone Phosphate is different in composition from samples of the same goods previously analyzed, owing to a change in the formula, as we are advised by the manufacturer.

The three brands of Peruvian Guano offered for sale by Hurtado & Co., Seth Chapman's Sons and possibly other New York dealers, are compared in the following table:

Peruvian Guano.

	Standard.		Guaranteed.	Lobos.
	1100	**1220**	**1099**	**1098**
Nitrogen as nitrates,	.22	.26	.29	.22
" of ammonia salts,	7.35	6.37	5.78	3.75
" of organic matter,	.48	.90	.59	.87
Soluble phosphoric acid,	2.54	2.16	2.00	4.04
Reverted phosphoric acid,	3.72	4.68	4.98	4.38
Insoluble phosphoric acid,	8.60	9.06	10.89	8.76
Potash,	2.48	2.72	3.06	3.46
Cost,	$67.00	67.00	56.00	52.00
Valuation,	57.21	55.77	54.63	47.20
Nitrogen found,	8.05	7.53	6.66	4.84
" *guaranteed*,*	*7.41*	*7.41*	*5.35*	*4.12*
Phosphoric acid found,	14.86	15.90	17.87	17.18
" " *guaranteed*,	*13.00*	*13.00*	*17.00*	*15.00*
Potash found,	2.48	2.72	3.06	3.46
" *guaranteed*,	*2.00*	*2.00*	*3.00*	*2.00*

The average cost of the 52 superphosphates and guanos, whose cost could be ascertained, is $40.73, and the average valuation $33.13 per ton, a difference of $7.60 or about 22.9 per cent. of the valuation. In only one case was the cost less than the valuation. As has been fully explained on page 26 the valuation is intended to represent the retail cost in the Connecticut market of the *raw materials* of which the mixed goods are composed. The 22.9 per cent. of this retail cost (or $7.60 per ton on the average in the case of superphosphates) represents the manufacturer's expenses and profits in mixing, packing and selling the goods.

Last year the average cost of the superphosphates was $41.42 and the average difference between cost and valuation $6.50, or 18.6 per cent. of the valuation.

31 of the superphosphates were up to their guaranteed composition or above it, 15 were below guarantee in respect to one ingredient, 5 were below in respect to two ingredients and 1 was below guarantee in all particulars. The purchaser has the right to insist that the goods he buys shall be essentially up to guarantee.

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* Here and in the following pages wherever the guarantee is stated it is the manufacturer's *minimum* figure. Thus if the guarantee is "Ammonia 3–5," it is given in this report as "Nitrogen 2.47," which is the equivalent of ammonia 3 per cent.; 17 parts of ammonia containing 14 parts of nitrogen.

Goods made with reasonable care will show certain variations in composition which cannot be avoided and it may well happen that an article will be above guarantee on one ingredient and a little below it on another. Such differences may be overlooked, the larger amount on the one hand offsetting the deficiency on the other; but a serious deficiency in any one ingredient or a general deficiency in all should be made good by the seller.

The brand "Fish and Potash" has been a favorite one in this State and is now offered by a number of manufacturers. A comparison of the different articles of this name is given in the following table:

Fish and Potash.

	Williams, Clark & Co.	Quinnipiac Co., Plain.	Miles Co.	Chittenden's.	Quinnipiac Crossed-Fishes.	Bowker.	Russell Coe. (Davidge.)	Stearns'.
	1213	**1204**	**1162**	**1221**	**1132**	**1211**	**1291**	**1289**
Nitrogen of Nitrates	.09	----	----	----	----	----	----	----
Nitrogen of Ammon.	.31	.41	----	.11	.66	----	----	.45
Nitrogen of Organic, Matters	3.70	2.11	2.21	2.94	3.26	2.00	3.07	1.97
Soluble Phos. Acid	.24	.32	4.33	.64	2.05	3.59	1.99	1.51
Reverted Phos. Acid	3.22	4.25	1.67	2.00	2.49	2.09	3.30	2.39
Insoluble Phos. Acid	3.01	4.08	2.27	4.33	1.28	2.95	1.78	1.65
Potash	5.15	4.44	6.27	6.38	3.52	4.41	4.81	4.62
Cost	$34.00	33.00	36.00	35.00	38.00	35.00	40.00	40.00
Valuation	$29.66	25.97	27.88	26.44	28.66	25.34	27.89	22.60
Nitrogen Found	4.10	2.52	2.21	3.05	3.92	2.00	3.07	2.42
*Nitrogen Guaranteed**	*3.29*	*2.00*	----	*2.88*	*3.25*	*2.25*	*2.88*	*2.47*
Phos. Acid Found	6.47	8.65	8.27	6.97	5.82	8.63	7.07	5.55
Phos. Acid Guaranteed	*3.00*	*6.00*	----	*6.00*	*5.00*	*8.00*	*5.00*	*6.00*
Potash Found	5.15	4.44	6.27	6.38	3.52	4.41	4.81	4.62
Potash Guaranteed	*3.00*	*4.00*	----	*5.00*	*3.00*	*4.00*	*4.00*	*4.00*

* See foot-note, page 35.

In the table, on pages 45 and 46, is given a comparison of the analyses of different brands of superphosphates, which have been executed at this station since its establishment.

It serves to show the variations in the quality of the goods, or any changes made by the manufacturers in the formula by which they are compounded.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1237	Wilcox Acidulated Fish Guano.	L. Wilcox & Co., Mystic Bridge.	J. A. Lewis, Willimantic.	Station Agent.
1214	Wilcox Prepared Fertilizer.	" " "	" "	"
1099	Guaranteed Peruvian Guano.	....	Seth Chapman's Son & Co., 170 Front St., New York.	C. H. Cables, Thomaston.
1219	Shoemaker's Swift Sure Superphosphate.	M. L. Shoemaker, Philadelphia, Penn.	Manufacturer.	Manufacturer.
1218	Bosworth Bro's Superphosphate of Lime.	Bosworth Bros., Putnam.	J. A. Paine, Danielsonville.	Station Agent.
1128	Mapes' Complete Manure, "A" Brand.	Mapes, F. & P. G. Co., 158 Front St., New York City.	R. B. Bradley & Co., New Haven.	"
1129	Sanford's Bone Superphosphate.	Chas. Sanford, Redding Ridge.	Manufacturer.	Wm. H. Burr, Redding Ridge.
1144	Lister's Ammoniated Dissolved Bone Phosphate.	Lister Bros., Newark, N. J.	R. B. Bradley & Co., New Haven.	Station Agent.
1236	Darling's Animal Fertilizer.	L. B. Darling & Co, Pawtucket, R. I.	T. Pease & Son's Co., Windsor Locks.	Fred. B. Hathaway, Suffield.
1213	Williams, Clark & Co's Fish and Potash.	Williams, Clark & Co., 109 Pearl St. New York City.	J. A. Lewis, Willimantic.	Station Agent.
1143	Mapes' Complete Manure for light soils.	Mapes, F. & P. G. Co., 158 Front St., New York City.	Birdsey & Forster, Meriden.	"
1210	G. H. Harris & Son's Superphosphate.	G. H. Harris & Son. Eagleville.	Manufacturer.	Manufacturer.
1098	Peruvian Guano Lobos.	....	Seth Chapman's Son & Co., 170 Front St., New York.	C. H. Cables, Thomaston.
1235	H. J. Baker's A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., 215 Pearl St., New York City.	W. W. Cooper, Suffield.	Fred. D. Hathaway, Suffield.
1140	E. Frank Coe's Ammoniated Bone Superphosphate.	E. Frank Coe, Burling Slip, New York.	R. B. Bradley & Co., New Haven.	Station Agent.

Nitrogenous Superphosphates and Guanos.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1207	Baker's Pelican Bone Fertilizer.	H. J. Baker & Bro., 215 Pearl St., New York City.	Cochrane Bros., West Cornwall.	Station Agent.
1206	Baker's "A. A." Ammoniated Superphosphate.	H. J. Baker & Bro., 215 Pearl St., New York City.	J. H. Ives, Danbury.	"
1264	Baker's "A. A." Ammoniated Superphosphate.	H. J. Baker & Bro., New York.	J. E. Andrews, Mt. Carmel.	S. A. Smith, Cheshire.
1254	G. W. Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.	Manufacturer.	Manufacturer.
1215	Preston's Ammoniated Bone Superphosphate.	H. Preston & Sons, Greenpoint, L. I.	J. B. Merrow & Sons, Merrow.	Station Agent.
1177	Bradley's Superphosphate.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Peck Brothers, Northfield.	C. H. Cables, Thomaston.
1204	Quinnipiac Fish and Potash, Plain Brand.	Quinnipiac Fertilizer Co., New London.	Usher & Tinker, Plainville.	Station Agent.
1202	Universal Ammoniated Dissolved Bone.	Williams, Clark & Co., 109 Pearl St., New York.	" " "	"
1110	Dickinson's Ammoniated Bone Phosphate.	David Dickinson, Middle Haddam.	Manufacturer.	A. H. Worthington, Middle Haddam.
1216	Darling's Animal Fertilizer.	L. B. Darling & Co., Pawtucket, R. I.	J. B. Barstow, Norwich.	Station Agent.
1292	The Common Sense Fertilizer, No. 2.	Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	Quinebaug Store, Danielsonville.	"
1288	Lombard & Mathewson's Superphosphate.	Lombard & Mathewson, Warrenville.	Buck, Durkee & Stiles, Willimantic.	"
1186	Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.	G. W. Miller, Middlefield.	M. W. Terrill, Middlefield.
1130	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
1162	Miles Co's Fish and Potash.	G. W. Miles Co., Milford.	Manufacturer.	G. L. Fox, New Haven.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1222	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	J. E. Leonard, Jewett City.	Station Agent.
1282	Farmer's Friend Ammoniated Dissolved Bone.	Read & Co., New York.	M. V. B. Lamb, Norwich.	"
1221	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport.	Southmayd & Gardiner, Middletown.	"
1137	Bradley's Patent Superphosphate of Lime.	Bradley Fertilizer Co, Boston, Mass.	A. C. Sternberg, Hartford.	"
1208	Americus Brand Ammoniated Bone Superphosphate.	Williams, Clark & Co., 109 Pearl St, New York.	Usher & Tinker, Plainville.	"
1801	Bowker's Dissolved Bone.	Bowker Fertilizer Co., Boston, Mass.	Coburn & Gale, Hartford.	"
1132	Quinnipiac Fish and Potash, Crossed-fishes Brand.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	"
1211	Bowker's Fish and Potash.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Usher & Tinker, Plainville.	"
1100	Standard Peruvian Guano.	------------------- --------	Seth Chapman's Son & Co., 170 Front St., New York.	C. H. Cables, Thomaston.
1209	Original Coe's Superphosphate.	Wm. L. Bradley, Boston, Mass.	Smith & Sons, West Cornwall.	Station Agent.
1157	Buffalo Ammoniated Bone Superphosphate.	Buffalo Fertilizer Co. and Chemical Works, Buffalo, N. Y.	S. J. Hall, Meriden.	"
1141	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., Boston and New York.	Coburn & Gale, Hartford.	"
1220	Standard Peruvian Guano.	Hobson, Hurtado & Co., 63 Pine St., New York, Importers.	Southmayd & Gardiner, Middletown.	"
1272	Baker's Dissolved Bone.	Baker Fertilizer Co., N. Y. City.	Hubbell & Bradley, Saugatuck.	S. B. Wakeman, Saugatuck.
1205	Potato, Hop and Tobacco Phosphate.	Buffalo Fertilizer and Chemical Works, Buffalo, N. Y.	W. W. Foote, Danbury.	Station Agent.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1291	Davidge's Fish and Potash.	Russel Coe, Linden, N. J.	Smith & Sons, West Cornwall.	Station Agent.
1293	Davidge's Special Favorite.	" " "	" " "	"
1210	Russel Coe's Ammoniated Bone Superphosphate.	" " "	" " "	"
1305	Soluble Pacific Guano.	Glidden & Curtis, Boston, Mass.	H. A. Stillman, Hartford.	"
1223	Mitchell's Standard Superphosphate.	A. Mitchell, Linden, N. J.	John A. Paine, Danielsonville.	"
1289	Stearns', No. 1, Eagle Brand Fish and Potash.	Stearns & Co., New York and Fall River, Mass.	A. S. Russell & Co., Meriden.	"
1208	Cooke's Blood Guano.	Nat. Fertilizer Co., Bridgeport.	Burtis & Mead, New Canaan.	"
1320	Bradley's B. D. Sea Fowl Guano.	Bradley Fertilizer Co., Boston, Mass.	Manufacturer.	Manufacturer.
1313	Buffalo Superphosphate, No. 2.	Buffalo Fertilizer and Chemical Works, Buffalo, N. Y.	"	"
1198	Curtis' Reliable Phosphate.	J. G. Curtis, Elliotts.	"	"
1228	N. H. Fertilizer Co.'s Standard Superphosphate.	N. H. Fertilizer Co., New Haven.	"	Station Agent.
1316	Sparrow's Bone and Potash Phosphate.	Judson & Sparrow, 38 South Market St., Boston, Mass.	"	Manufacturer.
1311	Lister Bro's Standard Phosphate.	Lister Bros., Newark, N. J.	"	"
1314	Cooke's Dissolved Ground Bone.	Nat. Fertilizer Co., Bridgeport.	"	"
1317	Quinnipiac Extra Superphosphate.	Quinnipiac Fertilizer Co., New London.	"	"
1329	Stearns' Ammoniated Bone Superphosphate.	Stearns & Co., 149 Front St., New York.	"	"
1332	Paul Thomson's Charter Oak Fertilizer.	Paul Thomson, Hartford.	"	"

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
		From Nitrates.	From Ammonia.	From Organic Matters.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1287	Wilcox Acidulated Fish Guano	....	....	6.06	6.06	*3.29*	1.47	4.47	.26	6.20	*2.3*	....	....	....	....	$27.50	$35.54	*$8.04
1214	Wilcox Prepared Fertilizer	....	.83	3.05	3.88	*3.29*	3.89	2.87	3.03	9.79	.. ..	6.76	*5.50*	5.06	*5.50*	36.00	35.80	.20
1099	Guaranteed Peruvian Guano	.29	5.78	.59	6.66	*5.35*	2.00	4.98	10.89	17.87	*17.00*	6.98	....	3.06	*3.00*	56.00	54.63	1.37
1319	Swift Sure Superphosphate	.42	....	2.94	3.36	*2.47*	8.78	2.88	1.86	13.52	*14.00*	11.66	*9.00*	3.99	*4.00*	43.00	41.07	1.93
1218	Bosworth Bros'. Superphosphate of Lime	....	1.00	1.14	2.14	*2.00*	4.61	5.52	5.20	15.36	*14.00*	10.16	*8.50*	2.32	*2.00*	38.00	34.83	3.17
1128	Mapes' Complete Manure, "A" Brand	.80	.70	1.07	2.57	*2.47*	8.98	2.74	3.64	15.36	*10.00*	11.72	*8.00*	2.74	*2.50*	42.00	38.73	3.27
1129	Sanford's Bone Superphos.	....	....	1.58	1.58	*1.58*	5.38	3.91	6.04	15.33	*15.33*	9.29	*9.29*	2.39	*2.39*	35.00	31.59	3.41
1144	Lister's Ammoniated Dissolved Bone Phosphate	....	.56	1.48	2.04	*1.65*	8.24	1.60	1.61	11.45	*10.00*	9.84	*8.00*	1.89	*1.50*	35.00	30.80	4.20
1236	Darling's Animal Fertilizer	....	...	3.91	3.91	*4.00*	.75	6.79	8.42	15.96	*10.00*	7.54	....	4.47	*5.00*	45.00	40.74	4.26
1213	Williams, Clark & Co's Fish and Potash	.09	.31	3.70	4.10	*3.29*	.24	3.22	3.01	6.47	*3.00*	3.46	....	5.15	*3.00*	34.00	29.66	4.34
1143	Mapes' Complete Manure for Light Soils	.84	2.89	2.17	5.90	*5.00*	6.15	1.33	1.86	9.34	*7.00*	7.48	....	8.04	*6.00*	52.00	47.61	4.39
1310	G. H. Harris & Son's Superphosphate	....	...	2.76	2.76	....	2.89	5.25	4.57	12.71	....	8.14	....	....	....	35.00	30.38	4.62
1098	Peruvian Guano Lobos	.22	3.75	.87	4.84	*4.12*	4.04	4.38	8.76	17.18	*15.00*	8.42	....	3.46	*2.00*	52.00	47.20	4.80
1235	Baker's A. A. Ammoniated Superphosphate	....	1.62	1.26	2.88	*2.47*	9.33	.85	.49	10.67	....	9.82	*10.00*	2.66	*2.00*	40.00	35.06	4.94
1140	E. Frank Coe's Ammoniated Bone Superphos.	....	....	2.17	2.17	*2.06*	7.73	1.42	2.89	12.04	*11.00*	9.15	*9.00*	0.46	....	35.00	29.30	5.70

* Valuation exceeds cost.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
		From Nitrates.	From Ammonia.	From Organic Matters.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1207	Pelican Bone Fertilizer	----	1.54	.65	2.19	*1.86*	8.30	.23	36	8.89	----	8.53	*8.00*	2.82	*2.00*	$35.00	$29.11	$5.89
1206	"A. A." Ammoniated Superphosphate	----	1.63	.90	2.53	*2.47*	9.29	1.01	.55	10.85	----	10.30	*10.00*	2.83	*2.00*	40.00	34.07	5.93
1264	"A. A." Ammoniated Superphosphate	----	1.98	.46	2.44	*2.47*	8.85	1.32	.78	10.95	---	10.17	*10.00*	3.00	*2.00*	40.00	33.88	6.12
1254	G. W. Miller's Raw Bone Phosphate	----	----	4.28	4.28	---	3.93	3.12	1.42	8.47	----	7.05	----	5.86	----	43.00	36.86	6.14
1215	Preston's Ammon. Bone Superphosphate	----	.24	2.02	2.26	*2.06*	7.14	1.34	3.29	11.77	----	8.48	*9.00*	----	----	35.00	28.79	6.21
1177	Bradley's Superphosphate	.05	.98	1.61	2.64	*2.27*	8.14	1.37	3.22	12.73	*11.00*	9.51	*9.00*	3.09	*1.50*	42.00	35.05	6.95
1204	Quinnipiac Fish and Potash, Plain Brand	----	.41	2.11	2.52	*2.00*	.32	4.25	4.08	8.65	*6.00*	4.57	*4.00*	4.44	*4.00*	33.00	25.97	7.03
1202	Universal Ammon. Dissolved Bone	----	----	1.82	1.82	*1.65*	6.91	3.58	1.57	12.06	*10.00*	10.49	*9.00*	----	----	36.00	28.95	7.05
1110	Dickinson's Ammon. Bone Phosphate	----	----	4.30	4.30	----	4.41	4.20	4.76	13.37	----	8.61	----	----	----	45.00	37.87	7.13
1216	Darling's Animal Fertilizer	----	.39	3.00	3.39	*4.00*	.67	6.58	7.57	14.82	*10.00*	8.24	----	4.35	*5.00*	45.00	37.77	7.23
1292	The Common Sense Fertilizer, No. 2	.03	.75	1.58	2.36	*2.00*	.44	6.86	1.12	8.42	*4.00*	7.30	----	3.78	*3.00*	35.00	27.76	7.24
1288	Lombard & Mathewson's Superphosphate	----	----	2.66	2.66	----	3.32	5.50	3.61	12.43	----	8.82	----	.17	----	38.00	30.43	7.57
1186	Miller's Raw Bone Phosphate	----	----	1.86	1.86	----	5.21	5.59	2.46	13.66	----	10.80	----	6.04	----	43.00	35.26	7.74
1130	Quinnipiac Phosphate	----	.43	2.43	2.86	*2.47*	7.52	1.32	.90	9.74	*9.00*	8.84	*8.00*	2.62	*2.00*	40.00	32.07	7.93
1162	Miles Co's Fish and Potash	----	----	2.21	2.21	----	4.33	1.67	2.27	8.27	----	6.00	----	6.27	----	36.00	27.88	8.12

NITROGENOUS SUPERPHOSPHATES AND GUANOS.—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
												Available.						
		From Nitrates.	From Ammonia.	From Organic Matters.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1222	Bay State Fertilizer......	.58	.56	1.77	2.91	*2.10*	7.76	1.24	1.99	10.99	*9.50*	9.00	*8.00*	3.17	*2.00*	$42.00	$33.86	$8.14
1282	Farmer's Friend Ammon. Dissolved Bone	.65	.88	.42	1.95	*1.86*	4.77	4.23	2.58	11.58	*8.00*	9.00	....	1.62	*2.00*	37.00	28.74	8.26
1221	Chittenden's Fish and Potash	....	.11	2.94	3.05	*2.88*	.64	2.00	4.33	6.97	*6.00*	2.64	....	6.38	*5.00*	35.00	26.44	8.56
1137	Bradley's Patent Superphosphate of Lime	....	....	2.32	2.32	*2.26*	8.53	1.39	2.88	12.80	*11.00*	9.92	*9.00*	2.08	*1.50*	42 00	33.20	8.80
1203	Americus Brand Ammon. Bone Superphosphate..	.11	....	2.12	2.23	*1.65*	6.93	2.38	1.11	10.42	*10.00*	9.31	*9.00*	1.16	*1.00*	38.00	29.01	8.99
1301	Bowker's Dissolved Bone.	....	....	1.51	1.51	*1.65*	7.70	1.16	.99	9.85	*8.00*	8.86	*5.00*	1.77	*2.00*	35.00	25.92	9.08
1132	Fish and Potash, Crossed-fish Brand	....	.66	3.26	3.92	*3.25*	2.05	2.49	1.28	5.82	*5.00*	4.54	*3.00*	3.52	*3.00*	38.00	28.66	9.34
1211	Bowker's Fish and Potash	....	....	2.00	2.00	*2.25*	3.59	2.09	2.95	8.63	*8.00*	5.68	....	4.41	*4.00*	35.00	25.34	9.66
1100	Standard Peruvian Guano	.22	7.35	.48	8.05	*7.41*	2.54	3.72	8.60	14.86	*13.00*	6.26	....	2.48	*2.00*	67.00	57.21	9.79
1209	Original Coe's Superphos.	....	....	2.31	2.31	*2.06*	7.31	1.75	3.52	12.58	*11.00*	9.06	*9.00*	....	....	40.00	30.18	9.82
1157	Buffalo Ammoniated Bone Superphosphate.......	....	.32	3.08	3.40	*2.50*	7.06	.91	2.20	10.17	*9.00*	7.97	*8.00*	1.32	*2.00*	43.00	32.59	10.41
1141	Bowker's Hill and Drill Phosphate	....	.79	1.47	2.26	*1.65*	7.62	.97	.96	9.55	*10.00*	8.59	*8.00*	2.29	*2.00*	40.00	29.16	10.84
1220	Standard Peruvian Guano	.26	6.37	.90	7.53	*7.41*	2.16	4.68	9.06	15.90	*13.00*	6.84	....	2.72	*2.00*	67.00	55.77	11.23
1272	Baker's Dissolved Bone ..	....	....	1.42	1.42	*1.65*	7.60	.52	1.33	9.45	....	8.12	*5.00*	1.66	*2.00*	36.00	24.43	11.57
1205	Potato, Hop and Tobacco Phosphate	....	....	3.10	3.10	*2.00*	6.60	.61	2.16	9.37	*9.00*	7.21	*8.00*	4.76	*6.00*	45.00	33.31	11.69
1291	Davidge's Fish and Potash	....	....	3.07	3.07	*2.88*	1.99	3.30	1.78	7.07	*5.00*	5.29	....	4.81	*4.00*	40.00	27.89	12.11
1298	" Special Favorite	....	....	2.22	2.22	*1.24*	4.22	3.16	2.61	9.99	*11.00*	7.38	*8.00*	1.81	*1.50*	40.00	26.90	13.10

NITROGENOUS SUPERPHOSPHATES AND GUANOS.—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
												Available.						
		From Nitrates.	From Ammonia.	From Organic Matters.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1210	Russel Coe's Ammoniated Bone Superphosphate	----	----	2.21	2.21	*1.86*	5.54	1.15	3.48	10.17	*11.00*	6.69	*10.00*	1.76	*1.50*	$40.00	$26.62	$13.38
1305	Soluble Pacific Guano	----	----	2.37	2.37	*2.50*	6.48	1.50	4.17	12.15	*10.00*	7.98	*8.00*	3.16	*2.00*	45.00	31.58	13.42
1223	Mitchell's Standard Superphosphate	----	.14	1.73	1.87	*2.06*	3.64	2.09	4.50	10.23	*10.00*	5.73	*8.00*	1.69	*3.00*	38.00	24.07	13.93
1289	Stearns' No. 1 Eagle Brand Fish and Potash	----	.45	1.97	2.42	*2.47*	1.51	2.39	1.65	5.55	*6.00*	3.90	*3.00*	4.62	*4.00*	40.00	22.60	17.40
1208	Cooke's Blood Guano	.07	----	1.66	1.73	*1.65*	4.85	1.30	4.49	10.64	*10.00*	6.15	*7.00*	3.10	----	45.00	25.58	19.42
1320	B. D. Sea Fowl Guano	.28	----	2.70	2.98	*2.50*	7.70	1.43	2.51	11.64	*11.00*	9.13	*9.00*	3.14	*2.00*	----	34.71	----
1313	Buffalo Superphos., No. 2	----	----	----	----	----	6.97	3.97	2.03	12.97	*13.00*	9.00	*11.00*	1.02	*2.50*	----	23.79	----
1198	J. G. Curtis' Reliable Phosphate	----	----	1.60	1.60	*1.60*	2.69	1.80	3.06	7.55	*7.55*	4.49	*4.49*	----	----	----	17.77	----
1228	N. H. Fertilizer Co.'s Superphosphate	1.91	----	1.25	3.16	----	3.63	1.22	4.78	9.63	----	4.85	----	2.87	----	----	29.22	----
1316	Sparrow's Bone and Potash Phosphate	----	1.06	1.94	3.00	*2.50*	10.55	1.78	.40	12.73	----	12.33	*9.00*	4.32	*4.00*	----	40.75	----
1311	Lister Bros.' Stand. Phosphate	----	----	2.47	2.47	*2.34*	9.40	2.07	.31	11.78	*12.00*	11.47	*10.00*	2.53	*1.50*	----	36.89	----
1314	Cooke's Dissolved Ground Bone	----	----	1.10	1.10	----	4.14	1.88	7.42	13.44	*11.40*	6.02	----	3.77	----	----	21.94	----
1317	Quinnipiac Extra Superphosphate	----	.56	1.99	2.55	*1.75*	3.92	3.84	2.47	10.23	*10.00*	7.76	*8.00*	2.59	*2.00*	----	29.59	----
1329	Stearns' Ammoniated Bone Superphosphate	----	.43	2.48	2.91	*2.47*	7.19	2.76	1.39	11.34	*9.00*	9.95	*8.00*	2.91	*2.00*	----	34.88	---
1332	Thomson's Charter Oak																	

COMPARISON OF SUPERPHOSPHATES OF THE SAME BRAND.

NAME.	No. of Analyses.	Year when Analyzed.	Nitrogen.	Phos. Acid.		Potash.
				Available.	Total.	
Baker's, H. J., A. A. Superphosphate	3	1882	3.03	9.59	10.16	2.82
	3	1883	2.61	9.55	10.04	2.74
	3	1884	2.62	10.09	10.82	2.83
Bosworth Bros' Superphosphate ---	1	1882	2.10	10.11	14.28	2.23
	1	1883	1.83	8.51	16.41	2.23
	1	1884	2.14	10.16	15.36	2.32
Bowker's Fish and Potash..........	1	1882	2.18	5.30	7.46	5.44
	1	1884	2.00	5.68	8.63	4.41
Bowker's Hill and Drill Phosphate.	1	1881	2.40	7.56	12.16	2.49
	1	1883	1.81	7.17	10.75	1.59
	1	1884	2.26	8.59	9.55	2.29
Bradley Fertilizer Co's Superphos. ..	1	1878	2.51	7.22	7.65	----
	1	1880	3.06	8.35	9.60	1.46
	1	1882	2.67	9.71	11.46	1.74
	2	1883	2.78	9.34	11.84	1.93
	2	1884	2.48	9.71	12.76	2.58
Coe, E. F., Superphosphate	7	1878	2.36	8.84	11.92	----
	2	1879	2.52	10.61	12.11	----
	1	1880	2.61	9.69	11.75	----
	1	1881	2.34	9.60	12.29	----
	1	1882	2.63	9.45	12.25	----
	1	1883	2.19	9.53	13.26	----
	1	1884	2.17	9.15	12.04	----
Coe, Russel, Superphosphate	3	1878	1.86	6.48	15.27	----
	1	1879	1.99	9.76	13.22	----
	2	1880	.99	5.73	14.18	1.35
	1	1882	2.10	9.96	11.78	1.41
	2	1883	2.30	7.63	9.08	1.24
	1	1884	2.21	6.69	10.17	1.76
Cooke's Blood Guano	1	1881	2.49	8.13	13.27	2.26
	1	1882	1.88	6.94	11.21	1.54
	1	1883	1.79	7.40	8.31	1.48
	1	1884	1.73	6.15	10.64	3.10
Darling's Animal Fertilizer	1	1881	4.09	6.47	13.61	6.47
	1	1882	4.20	8.16	13.27	5.95
	1	1883	3.91	6.45	15.16	4.68
	2	1884	3.65	7.89	15.39	4.41
Dickinson's Phosphate	5	1881	3.47	13.71	17.01	.34
	1	1884	4.30	8.61	13.37	----
Glidden & Curtis' Sol. Pacific Guano	2	1877	2.41	----	12.53	1.26
	2	1878	2.18	7.21	11.22	4.23
	1	1880	3.28	8.07	10.79	3.98
	2	1881	2.48	8.03	11.77	2.02

NAME.	No. of Analyses.	Year when Analyzed.	N trogen.	Phos. Acid.		Potash.
				Avail-able.	Total.	
Glidden & Curtis' Sol. Pacific Guano	1	1882	2.31	8.10	12.98	3.11
	1	1883	2.60	6.81	12.47	2.54
	1	1884	2.37	7.98	12.15	3.16
Harris' Phosphate	1	1881	2.93	11.95	14.67	----
	1	1882	3.08	10.69	14.50	.35
	1	1883	2.92	8.73	14.46	----
	1	1884	2.76	8.14	12.71	----
Lister Bros' Superphosphate	1	1880	2.20	8.59	11.03	----
	1	1883	1.69	10.74	11.68	1.89
	1	1884	2.47	11.47	11.78	2.53
Lombard & Mathewson's Superphos.	1	1878	1.59	7.45	8.35	----
	2	1879	3.12	12.23	17.08	----
	1	1880	3.61	13.25	16.22	----
	1	1881	2.91	9.69	15.39	----
	1	1882	2.46	12.43	13.11	.26
	1	1884	2.66	8.82	12.43	----
Mapes' Complete "A" Brand	2	1880	2.78	9.80	13.30	3.22
	1	1881	2.30	10.93	13.20	3.25
	1	1883	2.68	10.49	13.71	2.89
	1	1884	2.57	11.72	15.36	2.74
Mapes' Complete, for sandy soils	1	1881	5.36	5.82	7.83	6.68
	1	1883	5.29	7.84	8.96	6.61
	1	1884	5.90	7.48	9.34	8.04
Miles, G. W. Co., Superphosphate	1	1880	1.90	7.70	13.95	1.76
	1	1881	2.20	7.56	9.70	3.46
	1	1882	1.70	8.60	10.79	1.90
	3	1883	2.11	8.15	11.44	1.70
Miller, G. W., Raw Bone Phosphate	1	1880	3.41	9.19	12.80	5.09
	3	1883	2.92	6.29	9.90	5.64
	2	1884	3.07	8.92	11.06	5.95
Quinnipiac Fertilizer Co's Phosphate	2	1878	3.05	7.21	9.79	2.24
	2	1880	3.26	8.49	13.61	2.41
	2	1881	2.64	10.16	11.42	2.21
	1	1882	3.00	8.19	11.10	2.35
	5	1883	3.14	8.39	10.74	2.50
	1	1884	2.86	8.84	9.74	2.62
Quinnipiac Fertilizer Co's Fish and Potash.	2	1880	4.38	4.78	6.15	3.29
	1	1881	3.56	3.71	6.87	3.20
	2	1882	3.80	4.23	8.08	4.08
	2	1883	4.19	5.16	8.48	4.55
	1	1884	3.92	4.54	5.82	3.52

HOME-MADE PHOSPHATES.

During the last two or three years a number of farmers have purchased fertilizing chemicals in the New York or Connecticut market and compounded them to suit their own purposes. Seven samples of such home-made, or more properly speaking home-mixed, fertilizers have been examined during this year.

The analyses are given in the following table :

	Webb.		Augur.	Hathaway.	Pinney	Mason.	Baldwin.
	1188	**1248**	**1111**	**1124**	**1101**	**1267**	**1191**
Nitrogen of nitrates,							3.79
Nitrogen of ammonia,	3.70	3.52					
Nitrogen of organic matter,			2.04	3.81	4.09	4.42	2.86
Soluble phosphoric acid	6.57	9.21	7.34	none	none	none	7.06
Reverted phosphoric acid	4.96	2.44	3.41	3.54	3.68	2.68	.65
Insoluble phosphoric acid,	2.55	1.02	4.10	.54	3.06	.99	.05
Potash soluble in water	9.29	9.58		8.05	*7.24	†7.13	9.92
Cost per ton,	$36.20	36.20		25.63		33.70	50.00
Valuation per ton	$48.54	47.36	32.67	33.77	36.21	31.96	53.95

* Potash insoluble in water but soluble in acids, 1.74.
† " " " " " " " " .25

Nos. **1188** and **1248** were made and sent to the station by J. J. Webb, of Hamden.

In the *N. E. Homestead* of June 21 of this year, Mr. Webb says in substance with regard to them:

"For several years I have bought chemicals and mixed them myself and always, I think, with profitable results.

This year I sent the chemicals to the state experiment station for analyses and also the mixed phosphate. My mixed phosphate cost me, including the freight to New Haven and the labor of mixing, $36.20 per ton, and the station valuation was $48.54, or about 34 per cent. above cost.

I bought four tons of pure dissolved bone, 17 to 18 per cent. phosphoric acid, at $26.50 per ton; one ton of muriate of potash, 80 per cent. of muriate guaranteed, at $35, and one ton of sulphate of ammonia at $62.50. Thus the total cash cost of the six tons of chemicals was $203.50 or $33.92 per ton. The freight to New Haven and labor of mixing brought the cost up to $36.50.

The acid phosphate came in bags of 200 lbs. each, and was mixed by emptying one bag upon the barn floor and breaking the lumps as fine as we could with a shovel, then adding 100 lbs. of muriate of potash, also pulverized, then another bag of phosphate, covering with 100 lbs. of sulphate of ammonia and mixing all as well as we could conveniently with shovels. The mass was sifted through a coarse sieve. The lumps were thrown aside for further pulverization, after which they were returned. The prepared fertilizer was put in barrels, about 200 lbs. each, and set aside until wanted for use. This was done at an expense of 50 to 75 cents per ton. The goods were in better order for sowing than any phosphate I have ever bought."

Under date of Nov. 17 Mr. Webb writes to the station: "I was better satisfied with the mixture than with any prepared fertilizer I ever bought. My men used it on their gardens without any manure and had good crops and were highly pleased with it."

Mr. Webb adds in his published article: "We want the goods, and from my experience I think I cannot afford to do without them. But are the manufacturers doing the best they can afford by us? Are we not paying more than our share for long credits on goods sold at the South? Is it not more profitable for us to take the amount needed from the savings bank, if necessary, where it is drawing but 4 to 6 per cent. and pay cash for the goods, and save, say 20 per cent. or more?"

No. **1111** was made by C. P. Augur, of Whitneyville, but particulars with regard to its manufacture and cost have not been received.

Nos. **1124, 1101** and **1267** are tobacco fertilizers; the first from F. B. Hathaway, the second from R. E. Pinney, both of Suffield, and the last from John Mason, of Warehouse Point. Probably all were compounded by the same formula and at about the same cost. With regard to **1124,** Mr. Hathaway writes:

"The fertilizer in question has given good satisfaction here.

"It is composed of:

1,000 pounds cotton seed meal, costing	$13.63
500 pounds potash, costing	9.75
500 pounds lime, costing	2.25
	$25.63

"This is what it cost us in car-load lots last spring.

"It should be well mixed and put up in 100 pound bags.

"The expense of mixing won't exceed 50 cents per ton.

"The potash used was same as sample (No. **1149**) analyzed for me at Station last spring. The cotton seed and lime should both be the best that can be had and the fertilizers thus mixed should be applied to tobacco at the rate of two tons per acre. This makes a fertilizer analyzing about 30 per cent. more than the leading tobacco fertilizers and costing about the same per acre."

The "Potash" of Mr. Hathaway's formula is cotton hull ashes (see page 70). In this fertilizer there is no chlorine.

1191 is a sample of phosphate mixed for a potato fertilizer by M. S. Baldwin of Naugatuck.

Under date of Feb. 11 Mr. Baldwin writes: "The subject of chemical fertilizers has been discussed by our club and they wish me to ask you in what materials or in what form it is cheapest or most economical to buy nitrogen and phosphoric acid so that they will be in the most available form for crops to take up. To obtain potash is high grade muriate potash salts the best?"

To Mr. Baldwin was replied as follows: "The cost of nitrogen in nitrate of soda, dried blood and ammonia salts is about the same at present, rather higher in ammonia salts than in the others.

"Available phosphoric acid is cheapest in the high grade plain superphosphates, containing from 13–15 per cent. of phosphoric acid soluble in water. For most crops potash can be most cheaply supplied in high grade muriate of potash. We would suggest that you inquire of wholesale dealers as to their prices of nitrate of soda, guaranteed 95 per cent.; sulphate of ammonia, guaranteed 95 per cent.; dried blood, asking for nitrogen, guaranteed; plain superphosphate, guaranteed 13 to 15 per cent. water-soluble phosphoric acid, and muriate of potash, guaranteed 80 per cent. The goods to be in packages, delivered free on board in New York. You can then, knowing the freight rates, figure exactly what the things will cost you in Naugatuck."

Mr. Baldwin seems to have figured on the cost of fertilizing chemicals to good purpose. With regard to his home-mixed potato fertilizer he writes:

"I have used ——— and ——— potato fertilizer for raising my crop of potatoes each year for the last eight or ten years till this season, when I used that of which you analyzed a sample (1191). I have this season the best crop that I ever raised."

The average cost of the five fertilizers whose costs and valuations are given is $36.34, the average valuation $43.12, the difference $6.78, or 15.7 per cent. of the valuation. With only one exception the valuation of these goods is considerably above their cost.

The mechanical condition of the goods was in all cases unexceptionable. They were fine and dry.

SPECIAL MANURES.

[See pages 54–57.]

Under this head are included all those fertilizers which are sold with a claim, tacit or expressed, that they are compounded with special reference to the wants of particular crops, and are specially adapted to feed such crops. In the opinion of the Director of this Station, "Special Fertilization" by the use of such fertilizers, implies a uniformity of soil that is not commonly met with in this State, and a greater knowledge of the characters of the soil and the laws of vegetable nutrition than we now possess.

The matter has been fully discussed in preceding reports, and needs no further mention here.

The special manures themselves are, however, good fertilizers, and on the average during this year have furnished plant food in a somewhat more concentrated form than other superphosphates and at a considerably cheaper rate, although their average ton-cost has been higher. This will appear from the following comparison:

	Average Cost.	Average Valuation.	Difference.	Percentage difference reckoned on Valuation.
Superphosphates (52),	$40.73	33.13	7.60	22.90
Special manures (20),	49.95	44.20	5.75	13.00

The question arises, Why should the difference between cost and valuation be less in the case of special manures than in other superphosphates? It might be answered that the special manures are compounded mostly by those who manufacture on a large scale and are thus enabled to do the work of compounding more cheaply than smaller operators. If this is the explanation, then the superphosphates which are not specials, made by those same firms ought to show about the same percentage difference between cost and valuation that their specials show. But they do not. The average cost of all the nitrogenous superphosphates made by the same firms whose special manures are here tabulated, is $38.80, average valuation $32.28, average difference between cost and valuation $6.52, which is 20.2 per cent. of the valuation as against 22.9 per cent., the average in the case of *all* nitrogenous superphosphates.

Probably this difference is partly explained by the fact that the specials, almost without exception, have contained very considerable amounts of ammonia salts. Nitrogen in form of ammonia has been valued by the Station at 22 cents per pound, as agreed by the Directors of the Massachusetts, New Jersey and Connecticut Stations last spring. It is now seen that this valuation was too high, and 18 or 19 cents would have been fairer. Nitrogen in form of sulphate of ammonia has been bought by farmers in this State in ton lots as low as 16 cents per pound during the last season.

A further explanation of the more favorable relation of valuation to cost in the case of the special manures, is that pound for pound they contain more valuable material. The cost of mixing and selling a high grade article can hardly be greater than that of a lower grade. But in the first case, this cost of the preparation of the goods *goes further* with the farmer than in the latter case. To illustrate: suppose we have two lots of fertilizers unmixed. One contains 250 pounds of muriate of potash, 250 pounds of nitrate of potash and 600 pounds of plain superphosphate, with as much more moisture, sand, peat or plaster, so that the total weight is 2,200 pounds. Its cost is $19. This we propose to mix and apply to an acre of land. The other lot contains 500 pounds of muriate, 500 pounds of nitrate and 1,200 pounds of superphosphate, without any "ballast." It also weighs 2,200 pounds and costs $38. To sift, pulverize and mix thoroughly the raw materials in each lot we will assume costs $6. Since the weight of the two lots is the same, the labor of handling and mixing will not be very unlike.

When the fertilizers are spread on the land the first lot covers one acre and costs $19 plus $6=$25. The second lot covers two acres and costs $38 plus $6=$44, or $22 per single acre. Here, then, is a saving of $3 per acre, and a saving it is to be noticed, made by buying the highest priced fertilizer instead of the low priced one. The $25 goods are the more expensive, the $44 goods are the cheaper, if both are rationally used. We are not now arguing for specials as against other superphosphates, but for high grade goods, whether specials or not, as against the more expensive low grade goods.

Nine of the specials were up to their guarantees in all respects; in nine, one ingredient was not up to the guarantee, and two were deficient in respect to two ingredients.

In the following table are given all the analyses of various brands of special manures which have been made since the establishment of the Station in 1877, and which serve to show any changes in the formulas as well as the variations in the quality of the goods.

Comparison of Special Manures of the same Brand.

NAME.	No. of Analyses.	Year.	Nitrogen.	Phos. Acid.		Potash.
				Available.	Total.	
Baker's Potato Manure	2	1882	3.83	4.95	5.03	9.68
	1	1883	3.26	7.54	7.97	9.76
	1	1884	3.46	5.88	6.55	9.79
Baker's Oat Manure	1	1881	4.41	5.43	7.51	11.12
	1	1884	4.42	5.24	5.38	10.13
Baker's Tobacco Manure	1	1881	4.43	5.16	6.44	11.98
	1	1882	4.76	2.66	2.68	8.56
	1	1883	4.85	4.93	5.32	9.03
	1	1884	5.01	5.18	5.53	9.47
Baker's Corn Manure	3	1882	4.52	5.61	5.88	8.49
	1	1883	4.15	6.50	7.28	7.91
	1	1884	3.63	6.41	6.96	7.70
Baker's Grass Manure	1	1883	4.87	5.29	6.51	8.19
	1	1884	4.64	5.40	6.44	7.95
Chittenden's Complete Manure for Grain.	1	1883	4.24	8.25	9.09	5.37
	1	1884	3.51	7.03	8.93	6.49
Chittenden's Root Fertilizer	2	1883	3.98	7.84	8.79	5.78
	1	1884	4.22	7.67	9.02	5.56
Forrester's Special Potato Fertilizer	1	1878	5.65	7.57	7.65	11.42
	2	1879	4.69	5.39	7.10	9.68
	1	1880	4.76	5.44	7.53	11.33
	1	1881	3.38	5.44	5.72	9.50
	1	1882	3.78	6.91	7.22	10.27
	1	1884	4.68	7.87	8.55	9.83
Forrester's Special Grass Fertilizer	1	1878	5.56	4.08	5.12	12.11
	1	1880	5.44	2.12	3.07	7.45
Forrester's Special Onion Fertilizer	1	1879	7.36	4.49	4.84	7.39
	1	1880	7.40	4.63	5.63	7.25
	2	1881	5.24	5.16	5.41	6.53
	1	1882	5.53	6.23	6.63	5.69
	1	1884	5.58	9.45	9.45	7.58
Forrester's Special Cabbage Fertilizer	1	1879	6.27	6.06	6.51	7.44
	1	1880	5.62	6.26	6.82	8.16
Forrester's Special Corn Fertilizer	1	1879	7.91	4.20	4.49	8.30
	1	1880	4.86	6.07	7.08	14.56
	2	1881	5.04	6.79	7.20	7.65
	1	1882	5.30	7.78	8.56	8.06
	1	1884	4.71	9.18	9.89	7.84
Forrester's Special Oat Manure	1	1880	6.62	4.96	5.94	9.18
	1	1881	4.79	5.99	6.32	8.61
Lister's Potato Fertilizer	1	1883	3.79	8.13	8.87	8.43
	1	1884	3.74	9.13	9.27	6.72
Mapes' Grass and Grain Top Dressing	1	1879	4.28	5.99	7.31	3.65
	1	1880	4.74	7.49	8.79	6.61
	1	1883	4.11	7.09	9.76	5.98

SPECIAL MANURES.—*Continued.*

NAME.	No. of Analyses.	Year.	Nitrogen.	Phos. Acid.		Potash.
				Available.	Total.	
Mapes' Potato Fertilizer	1	1878	3.67	4.55	6.04	14.82
	1	1880	3.67	9.44	10.94	6.35
	1	1882	3.94	7.86	10.04	6.10
	2	1883	4.22	7.98	11.83	6.55
	1	1884	4.27	8.92	12.66	6.82
Mapes' Corn Manure	1	1880	3.67	10.20	11.86	7.21
	1	1881	3.63	9.44	12.04	5.67
	2	1882	3.77	10.63	12.32	7.04
	1	1884	4.04	8.80	12.51	6.82
Mapes' Tobacco Manure, Ct. Brand	1	1881	4.86	5.61	7.46	7.42
	1	1882	3.62	7.77	9.41	9.03
	1	1883	6.41	7.64	8.84	6.70
	1	1884	5.26	7.65	10.09	7.44
Mapes' Tobacco Manure, for use with Stems.	2	1882	5.73	7.54	9.74	4.36
	1	1883	5.31	9.60	10.91	4.35
	1	1884	6.09	11.24	13.67	3.70
Stockbridge Grain Manure	2	1878	6.06	5.51	6.33	6.87
	1	1880	4.71	6.00	6.42	6.75
	1	1881	4.04	6.81	8.78	5.29
	2	1882	3.83	6.89	8.78	5.25
	1	1883	3.83	7.12	5.36	3.93
Stockbridge Vegetable Manure	1	1878	3.49	6.39	6.57	10.22
	-	1879	3.82	7.02	7.21	8.84
	2	1881	3.12	6.81	7.99	4.89
	2	1882	3.40	7.47	9.95	4.90
	1	1883	2.94	6.65	8.48	6.10
	1	1884	3.35	6.72	8.76	10.12
Stockbridge Kitchen Garden Manure	1	1878	4.57	5.62	5.79	7.22
Stockbridge Squash, Cucumber and Tomato Manure.	1	1878	5.06	4.05	4.05	7.66
Stockbridge Grass Top Dressing	1	1878	8.68	2.11	2.11	10.38
	1	1879	6.10	4.09	4.45	7.52
	1	1882	4.05	6.72	9.49	3.69
Stockbridge Top Dressing and Forage Crop.	1	1883	4.04	6.40	7.89	4.05
	1	1883	3.29	7.25	10.86	4.06
	1	1884	3.81	7.01	8.75	3.60
Stockbridge Lawn Dressing	1	1878	7.99	5.17	5.17	6.35
Stockbridge Grain Manure	1	1881	3.20	7.46	7.59	5.89
	1	1882	3.48	6.57	9.14	6.83
	1	1883	3.39	7.42	10.81	5.31
	1	1884	2.91	7.98	9.10	5.51
Stockbridge Onion Manure	1	1879	3.91	6.36	6.49	8.32
	1	1880	3.10	5.34	5.79	7.94
Stockbridge Tobacco Manure	1	1879	5.70	1.43	1.70	7.36
	1	1880	6.11	6.09	6.29	5.62
Stockbridge Root Manure	2	1880	3.95	5.53	6.20	7.02
Stockbridge Seeding Down Manure	1	1883	3.37	7.46	10.92	5.88

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1303	Mapes' Tobacco Manure, for use with stems.	Mapes' Formula and Peruvian Guano Co., New York.	Mapes' Conn. Valley Branch, Hartford.	Station Agent.
1271	Forrester's Onion Manure.	G. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1212	Baker's Special Tobacco Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	Southmayd & Gardiner, Middletown.	Station Agent.
1304	Mapes' Tobacco Manure, Ct. Brand.	Mapes' Formula and Peruvian Guano Co., New York.	Mapes' Conn. Valley Branch.	"
1283	Bosworth's Potato Phosphate.	Bosworth Bros., Putnam.	John A. Paine, Danielsonville.	"
1274	Forrester's Corn Manure.	G. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1275	" Potato Manure.	G. B. Forrester, 169 Front St., New York.	"	"
1302	Baker's Special Oat Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	Tolles & McKwen, Naugatuck.	Station Agent.
1318	Read & Co's Matchless Tobacco Manure.	Read & Co., New York City.	A. C. Sternberg, Hartford.	Manufacturer.
1138	Mapes' Potato Manure.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	R. B. Bradley & Co., New Haven.	Station Agent.

Special Manures.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1160	Bowker's Vegetable Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston.	Coburn & Gale, Hartford.	Station Agent.
1226	Chittenden's Complete Root Fertilizer.	National Fertilizer Co., Bridgeport.	Manufacturer.	Josiah Hawkins, Southport.
1131	Mapes' Corn Manure.	Mapes' Formula and Peruvian Guano Co., New York.	R. B. Bradley & Co., New Haven.	Station Agent.
1300	Baker's Complete Grass Manure.	H. J. Baker & Bro., 215 Pearl St., New York City.	"	"
1142	Lister Bros' Potato Manure.	Lister Bros., Newark, N. J.	"	"
1307	Chittenden's Complete Fertilizer for Grain.	National Fertilizer Co., Bridgeport.	E. A. Watrous, Meriden.	"
1155	Bowker's Corn and Grain Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston.	Coburn & Gale, Hartford.	"
1136	Baker's Special Corn Manure.	H. J. Baker & Bro., 215 Pearl St., New York City.	R. B. Bradley & Co., New Haven.	"
1139	Baker's Complete Potato Manure.	H. J. Baker & Bro., 215 Pearl St., New York City.	"	"
1286	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	"

SPECIAL MANURES—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Valuation Exceeds Cost.
		From Nitrates.	From Ammonia.	From Organic Matters.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1303	Mapes' Tobacco Manure for use with stems	.81	3.34	1.94	6.09	*5.35*	7.85	3.39	2.43	13.67	*10.50*	11.24	....	3.70	*3.50*	$52.00	$54.61	$2.61
1271	Forrester's Onion Manure	....	5.58	....	5.58	*5.35*	9.05	.40	tr'ce	9.45	....	9.45	*3 50*	7.58	*7.00*	48.50	50.83	2.33
1212	Baker's Special Tobacco Manure	...	4.34	.67	5.01	*4.54*	3.91	1.27	.35	5.53	....	5.18	*4.00*	9.47	*8.00*	47.50	45.94	Cost Exceeds Valuation. 1.56
1304	Mapes' Tobacco Manure, Conn. Brand	.84	3.97	.45	5.26	*4.74*	5.42	2.23	2.44	10.09	*7.75*	7.65	....	7.44	*7.75*	52.00	50.13	1.87
1283	Bosworth's Potato Phosphate	....	2.17	.60	2.77	*2.50*	5.87	3.33	2.24	11.44	*10.00*	9.20	....	7.89	*7.50*	42.00	39.98	2.02
1274	Forrester's Corn Manure	....	4.71	....	4.71	*3.91*	8.73	.45	.71	9.89	....	9.18	*6.50*	7.84	*8.00*	49.50	46.47	3.03
1275	" Potato Manure	....	4.68	....	4.68	*3.70*	7.06	.81	.68	8.55	....	7.87	*5.25*	9.83	*10.00*	49.50	46.35	3.15
1302	Baker's Special Oat Manure	3.61	....	.81	4.42	*4.12*	4.86	.38	.14	5.38	....	5.24	*5.00*	10.13	*9.00*	47.00	43.12	3.88
1318	Read & Co's Matchless Tobacco Manure	....	4.85	....	4.85	*5.35*	5.74	1.20	.92	7.86	*9.00*	6.66	....	4.59	*4.50*	46.00	41.40	4.60

SPECIAL MANURES.—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
		From Nitrates.	From Ammonia.	From Organic Matters.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.			
												Found.	Guaranteed.					
1138	Mapes' Potato Manure	.91	1.96	1.40	4.27	*3.70*	5.85	3.07	3 74	12.66	*8.00*	8.92	....	6.82	*6.00*	$51.00	$44.96	$6.04
1160	Stockbridge Potato Manure	....	1.09	2.16	3.25	*3.25*	6 21	.51	2.04	8.76	*8.00*	6.72	*8.00*	10.12	*7.00*	45.00	38.68	6.32
1226	Chittenden's Complete Root Fertilizer	.77	2.37	1.08	4.22	*3.29*	6.54	1.13	1.35	9.02	*8.00*	7.67	*6.00*	5.56	*6.00*	45.00	38.57	6.43
1131	Mapes' Corn Manure	.87	2.16	1.01	4.04	*3.70*	6.07	2.73	3.71	12.51	*10.00*	8.80	....	6.82	*6.00*	*50.00	42.86	7.14
1300	Baker's Complete Grass Manure	.94	3.12	.58	4.64	*3.70*	4.72	.68	1.04	6.44	*5.00*	5.40	....	7.95	*7.50*	45.00	37.77	7.23
1142	Lister Bros' Potato Manure	....	2.69	1.05	3.74	*3.29*	8.88	.25	.14	9.27	....	9.13	*8.00*	6.72	*7.00*	50.00	40.93	9.07
1307	Chittenden's Complete Fertilizer for Grain	....	....	3.51	3.51	*3.70*	5.08	2.55	1.30	8.93	*8.00*	7.63	*6.00*	6.49	*5.00*	45.00	35.48	9.52
1155	Stockbridge Grain Manure	....	1.55	1.76	3.31	*3.29*	7.58	.40	1.12	9.10	*7.00*	7.98	*6.00*	5.51	*4.00*	45 00	35.43	9.57
1136	Baker's Special Corn Manure	...	3.08	.55	3.63	*4.12*	5.95	.46	.55	6 96	....	6.41	*6.25*	7.70	*7.00*	*50.00	35.53	14.47
1139	Baker's Complete Potato Manure	....	2.82	.54	3.36	*3.29*	5.30	.58	.67	6.55	....	5.88	*5.00*	9.79	*10.00*	47.50	35.34	12.16
1286	Stockbridge Forage Crop Manure	1 12	1.03	1.66	3.81	*4.12*	6.14	.87	1.74	8.75	*7.00*	7.01	*6.00*	3.60	*4 00*	50.00	33.68	16.32

* Reckoned from cost per bag (200 lbs.).

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Bone Manures.

In the following tables are given analyses of 31 articles of thi class. In a number of cases to meet the requirement of the law manufacturers' samples have been analyzed, because the good were not found in market by the station agents.

The prices of bone ground in this State, given in the table, ar mostly the prices asked at the factories, delivered on board.

The samples analyzed this year vary greatly in quality. Hard firm bones contain more nitrogen and phosphoric acid tha the softer ones, which are often wet or greasy. "Kitchen Bone," and all bone gathered by pickers is apt to have some sand o earth adhering to it or lodged in the cavities of the bone. Fo these reasons "pure ground bone," so called, is not a thing of ver definite composition.

Some manufacturers of bone black have left after picking ou what is suitable for that purpose, a quantity of damp, soft bone which is mixed with a dryer or preservative, plaster or salt cake and sold as a fertilizer.

1145, 1284, and **1290** are examples of bone which is "bal lasted" with drying or preservative material. **1290** also contain 2.00 per cent. of potash. These articles are sold as "groun bone," but their guarantee indicates that they are not offere as *pure* bone.

The low valuation of Quinnipiac Bone No. **1158** is due both t the small amount of nitrogen and phosphoric acid in it and als to its mechanical condition. More that ⅜ of it by weight is i pieces that will not pass a ⅛ in. mesh.

Nos. **1242, 1240, 1229** all contain very considerable amount of sand and other worthless matter insoluble in strong acids **1242** contains 7.07 per cent. insoluble, **1240** contains 10.98 pe cent., and **1229** 33.49 per cent. "Kitchen Bones" gathered b bone-pickers would naturally have some sand adhering to the but when the ground bone contains over 5 per cent. of insolubl matter consisting of sand, soil, coal-ashes and like "dirt," o when the amount of phosphoric acid falls below 19 per cent there is reason to complain of adulteration, unless the guarante indicates that the article is not pure ground bone.

1229 is a sample with regard to which conflicting statement have reached the Station. The sender claims to have sold to th grinder "7600 lbs. of pure raw Bone at one cent per lb., with th

BONE MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1246	Peter Cooper's Ground Bone.	Peter Cooper's Glue Factory.	Manufacturer.	J. M. Milbank, Greenfield Hill.
1194	Rogers & Hubbard Co. Damp Bone Saw Dust.	Rogers & Hubbard Co., Middletown.	"	Manufacturer.
1237	Anderson's Ground Bone.	W. H. Anderson, Putnam.	"	"
1308	Bosworth Bros. Ground Bone.	Bosworth Bros., Putnam.	"	"
1146	Rogers & Hubbard Damp Bone Sawings.	Rogers & Hubbard Co., Middletown.	H. K. Brainard, Thompsonville.	Station Agent.
1273	Forrester's Pure Ground Bone.	Geo. B. Forrester, 159 Front St., New York City.	Manufacturer.	S. B. Wakeman. Saugatuck
1231	E. Smith's Ground Bone.	E. Smith, South Canterbury.	"	Manufacturer.
1197	Pure Ground Raw Knuckle Bone, "Grade A" Extra Fine.	Rogers & Hubbard Co., Middletown.	J. B. Barstow, Norwich.	Station Agent.
1266	F. C. Slade's Ground Bone.	F. C. Slade, Oakville.	Manufacturer.	"
1156	Shoemaker's Swift Sure Bone Meal	M. L. Shoemaker & Co., Philadelphia, Penn.	F. Ellsworth, Hartford.	"
1200	Peck Bros' Bone.	Peck Brothers, Northfield.	Manufacturer.	C. H. Cables, Thomaston.
1239	Peck Bros' Boiled Bone.	Peck Brothers, Northfield.	Manufacturer.	Manufacturer.
1195	Pure Ground Raw Knuckle Bone Grade "Meal."	Rogers & Hubbard Co., Middletown.	J. B. Barstow, Norwich.	Station Agent.
1265	G. W. Miller's Ground Bone	G. W. Miller, Middlefield.	Manufacturer.	"
1196	Rogers & Hubbard's Pure Ground Bone, Grade AX.	Rogers & Hubbard Co., Middletown.	Wilson & Burr, Middletown.	"

BONE MANURES.—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1219	Darling's Fine Ground Bone.	L. B. Darling & Co., Pautucket, R. I.	J. B. Barstow & Co., Norwich.	Station Agent.
1230	P. W. Bennett's Ground Bone.	P. W. Bennett, Rock Fall.	Manufacturer.	Manufacturer.
1238	Peck Bros' Raw Kitchen Bone.	Peck Brothers, Northfield.	"	"
1199	Atwood Brothers' Bone.	Atwood Brothers, Oakville.	"	C. H. Cables, Thomaston.
1242	" " Ground Bone.	" " "	"	Station Agent.
1241	F. C. Slade's Bone.	F. C. Slade, Oakville.	"	C. C. Churchill, Torrington. Forwarded by Peck Bros.
1145	Lister Bros' Celebrated Ground Bone.	Lister Bros., Newark, N. J.	R. B. Bradley & Co., N. Haven.	Station Agent.
1158	Quinnipiac Bone.	Quinnipiac Co., Wallingford.	S. J. Hall, Meriden.	"
1284	Preston's Ground Bone.	H. Preston & Sons, Green Point, L. I.	J. B. Merrow & Sons, Merrow.	"
1240	Atwood Bros' Ground Bone.	Atwood Brothers, Oakville.	Atwood Bros., Oakville.	C. C. Churchill, Torrington. Forwarded by Peck Bros.
1290	E. Frank Coe's Ground Bone.	E. F. Coe, 16 Burling Slip, New York.	Buck, Durkee & Stiles, Willimantic.	Station Agent.
1229	Ground Bone.	----------	----------	----------
1185	Flour of Bone.	----------	----------	M. W. Terrill, Middlefield.
1209	G. H. Harris & Son's Ground Bone.	G. H. Harris & Son, Eagleville.	Manufacturer.	Manufacturer.
1127	Meat and Bone.	Adams & Thomas, Springfield, Mass.	Adams & Thomas.	Geo. Wilcox, Shaker Station.
1330	Buckhorn Sawings.	Rogers & Hubbard, Middletown.	----------	Chas. Fairchild, Middletown.

BONE MANURES.—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than 1/50 inch.	Finer than 1/25 inch.	Finer than 1/12 inch.	Finer than 1/6 inch.	Coarser than 1/6 inch.	Cost per ton.	Valuation per ton.	Valuation exceeds cost.
1246	Peter Cooper's Ground Bone	1.48	31.65	50	15	24	11	----	$27.00	$39.71	$12.71
1194	Rogers & Hubbard's Damp Bone Saw Dust	2.49	17.09	93	6	1	----	----	25.00	29.23	4.23
1237	Anderson's Ground Bone	2.15	30.31	77	22	1	----	----	40.00	43.19	3.19
1308	Bosworth Bros' Ground Bone	4.09	21.95	36	32	29	3	----	35.00	37.26	2.26
1146	Rogers & Hubbard's Damp Bone Sawings	2.11	16.54	93	6	1	----	----	25.00	27.26	2.26
1273	Forrester's Pure Ground Bone	3.97	22.99	80	20	----	----	----	39.00	41.00	2.10
1197	Rogers & Hubbard Pure Raw Knuckle Bone "Gr. A," Ex. F.	4.12	24.19	30	23	47	----	----	38.00	39.10	1.10
1231	E. Smith's Ground Bone	3.93	20.59	32	38	24	6	----	34.00	35.08	1.08
1266	F. C. Slade's Ground Bone	4.15	21.59	29	36	14	10	11	35.00	35.57	.57
1156	Shoemaker's Swift Sure Bone Meal	6.62	19.82	59	31	10	----	----	45.00	45.23	.23
											Cost exceeds valuation.
1200	Peck Brother's Bone	3.97	22.21	15	21	42	18	4	35.00	34.29	.70
1239	" Boiled Bones	4.15	22.46	14	15	30	35	6	35.00	33.95	1.05
1195	Rogers & Hubbard Pure Raw Knuckle Bone Grade "Meal"	4.02	23.64	34	34	32	----	----	40.00	38.94	1.06
1265	Miller's Ground Bone	4.17	21.10	26	23	32	19	----	36.00	34.90	1.10

Bone Manures.—*Continued.*

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than				Coarser than $\frac{1}{8}$ inch.	Cost per ton.	Valuation per ton.	Cost exceeds valuation.
				$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{6}$ inch.				
1196	Roger's & Hubbard's Pure Ground Bone, Grade AX	4.04	21.27	26	23	37	14	----	$36.00	$34.87	$1.13
1219	Darling's Fine Ground Bone	3.51	22.98	77	16	7	---	----	42.00	39.10	2.90
1230	P. W. Bennett's Ground Bone	3.51	23.90	10	14	24	43	9	36.00	32.80	3.20
1238	Peck Bros' Raw Kitchen Bones	4.03	20.80	10	15	28	35	12	35.00	30.40	4.60
1199	Atwood Brothers' Bone	3.91	19.60	8	14	23	20	35	35.00	28.46	6.54
1242	" Ground Bone	3.74	18.59	12	20	26	24	18	35.00	28.58	6.42
1241	F. C. Slade's Bone	3.65	17.38	20	20	22	26	12	35.00	27.97	7.03
1145	Lister Bros' Celebrated Ground Bone	3.25	13.81	44	20	18	17	1	33.00	25.31	7.69
1158	Quinnipiac Bone	3.38	18.71	5	5	11	11	68	35.00	23.96	11.04
1284	Preston's Ground Bone	4.02	9.18	38	17	23	13	9	34.00	22.01	11.99
1240	Atwood Brothers' Ground Bone	3.17	15.81	9	12	22	22	35	35.00	22.95	12.05
1290	E. Frank Coe's Ground Bone	2.20	12.68	43	14	18	13	12	35.00	21.89	13.11
1229	Ground Bone	2.34	13.39	24	16	16	12	32	35.00	19.77	20.23
1185	Flour of Bone	1.50	30.03	87	13	----	----	----	----	40.97	----
1309	G. H. Harris & Son's Ground Bone	3.99	20.48	16	22	21	17	24	----	31.03	----
1127	Meat and Bone from Adams & Thomas	4.92	15.88	----	----	----	----	----	----	----	----
1330	Buckhorn Sawings	5.28	22.29	----	----	----	----	----	----	----	----

agreement that he would take 1000 lbs. of ground Bone as part payment, the balance to be cash." The sender writes that the grinder "makes it a part of his business to grind and sell Bone to the farmers of this vicinity." He also writes, "The price I paid ——— for the ground Bone was $35.00 per ton."

The grinder of this Bone, in verbal statement, was understood to say on the other hand, that he does "not sell bone but grinds bone for those who bring it," that "this bone was brought by and ground for the sender of the sample, and that it was so very sandy as to greatly injure the mill."

That Bones should carry so much as *one-third their weight* of sand, coal, and coal-ashes is difficult to understand. That various matters are often thrown into bone-mills to clear the grinding surfaces is well known. That the sample **1229** fairly represents the lot from which it was taken the Station cannot assert. Under these circumstances the results of the analysis are given but the names of the parties concerned are withheld.

1185, 1237, and **1246** are articles which have been boiled or steamed in the glue factory to remove their gelatine, etc. In consequence, the larger part of the nitrogen which they originally contained has been removed and the percentage amount of phosphoric acid is higher than in raw bone. The articles are fine and very dry. They are an excellent source of phosphoric acid in assimilable form. It is stated by the manufacturer that Nos. **1238** and **1239** are not brands entered for sale, but are ground and mixed to make the "Pure Ground Bone" No. **1200.**

Dry Ground Fish.

Five samples of Fish Scrap offered for sale in this State have been examined during the year. In all cases the goods have been considerably above their guarantee, and with one exception the valuation has been above the cost.

1217 was very wet, containing 27.71 per cent. of moisture. The "Manufacturer's Sample" of the same goods contained only 22.26 per cent. of water, and it is therefore possible that **1217** is damaged goods and does not fairly represent the brand.

The average cost of these five samples has been $39.00, and the average valuation $42.34.

DRY GROUND FISH.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1159	Stearns' Dry Ground Fish Guano.	Stearns & Co., New York and Fall River, Mass.	A. S. Russell, Meriden.	Station Agent.
1285	Wilcox Fish Guano, Dry Ground.	L. Wilcox & Co., Mystic Bridge.	J. A. Lewis, Willimantic.	"
1201	Bowker's Dry Ground Fish.	Bowker Fertilizer Co., 43 Chatham St., Boston. Mass.	Usher & Tinker, Plainville.	"
1135	Quinnipiac Dry Ground Fish.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	"
1217	Preston's Dried and Ground Fish Guano.	H. Preston & Sons, Green Point, L. I.	Wilson & Burr, Middletown.	"

DRY GROUND FISH—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.				Phosphoric Acid.					Available.		Cost per Ton.	Valuation per Ton.	Valuation Exceeds Cost.
		From Ammonia.	From Organic Matter.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.			
1159	Stearns' Dry Ground Fish	.68	8.13	8.81	*7.40*	.80	4.79	2.89	8.48	*7.00*	5.59	....	$40.00	$48.33	$8.33
1285	Wilcox Fish Guano, Dry Ground	....	8.54	8.54	*7.40*	1.85	4.70	.53	7.08	...	6.55	....	40.00	46.80	6 80
1210	Bowker's Dry Ground Fish	...	8.44	8.44	*6.60*	.90	3.78	2.73	7.41	....	4.68	....	40.00	44.82	4.82
1135	Quinnipiac Dry Ground Fish	.46	7.79	8.25	*7.40*	1.22	3.37	1.97	6.56	*6.00*	4 59	*2.00*	40.00	43.46	3.46
1217	Preston's Dried and Ground Fish Guano	...	4.26	4.26	*4.12*	2.01	3.60	.85	6.46	*5.00*	5.61		35.00	28.20	Cost exceeds valuation. 6.70

NITRATE OF SODA.

1244. Nitrate of Soda. Sold by H. J. Baker & Bro., New York City. Sampled and sent by J. M. Milbank, Greenfield Hill.

1192. Nitrate of Soda. Sold by Geo. B. Forrester, New York City. Sampled and sent by M. S. Baldwin, Naugatuck.

1182. Nitrate of Soda. Sold by Mapes F. & P. G. Co., New York. From stock bought by T. N. Bishop, Plainville. Sampled by Station Agent.

1176. Nitrate of Soda. Sold by Mapes F. & P. G. Co., New York. Sampled and sent by C. H. Cables, Thomaston.

	1244	1192	1182	1176
Nitrogen Guaranteed,		*16.1*	*15.6*	*15.8*
Nitrogen found,	16.13	16.02	15.90	15.95
Equivalent nitrate of soda,	97.93	97.30	96.55	96.84
Cost per ton,	$61.50	56.00	52.50	54.50
Nitrogen costs per lb.,	19.1 cts.	17.8 cts.	16½ cts.	17.1 cts.

Under date of January 17, 1884, Marshall Marsh, of New Milford, writes:

"I send you a sample of saltpetre bought of Martin Hungerford, Gaylordsville, Ct., which I wish you would please analyze and send me the result. This saltpetre was guaranteed to be pure and such as was used in the manufacture of powder. Cost 6¼ cents per pound."

The sample, No. **1063**, had the following composition:

Moisture,	1.25
Soda,	45.84
Potash,	none
Chlorine,	37.96
Nitric acid,	23.22
Sulphuric acid,	trace
Other matters by difference,	.28
	108.55
Deduct oxygen equivalent to chlorine,	8.55
	100.00

Its proximate composition may be represented as follows:

Sodium nitrate (Chili saltpetre),	36.55
Sodium chloride (common salt),	61.92
Water,	1.25
Other matters,	.28
	100.00

To Mr. Marsh was written:

"The sample contains, as you see, no trace of saltpetre, 'such as is used in the manufacture of gunpowder,' that is, nitrate of potash. It is a mixture of a little more than one-third Chili saltpetre, or soda saltpetre, and nearly two-thirds common salt. Such a mixture could only be applied to land with great caution, on account of this large proportion of salt.

"With regard to its commercial value: Pure Chili saltpetre, nitrate of soda, can be bought in this State for $70.00 per ton, or 3½ cents per pound. This material is not worth as a fertilizer more than one-third to one-half as much."

SULPHATE OF AMMONIA.

1257. Sulphate of Ammonia. Sold by National Fertilizer Company, Bridgeport. Sampled and sent by R. A. Moore, Kensington.

1173. Sulphate of Ammonia. From factory of E. H. Wardwell, in New Haven. Purchased in New York, sampled and sent by J. J. Webb, Hamden.

1102. Sulphate of Ammonia. From factory of E. H. Wardwell, in New Haven. Sampled by Station Agent.

	1257	1173	1102
Nitrogen,	20.63	20.37	20.22
Equivalent ammonia,	25.05	24.74	24.56
" sulphate ammonia,	97.26	96.03	95.32
Cost per ton,	$65.00	62.50	
Nitrogen costs per lb.,	16.3 cts.	15.3 cts.	

MEAT AND PLASTER.

1312 is a sample of meat and plaster, made by W. Burr Hall, of Wallingford, and sent to the Station by him as manufacturer's sample. The analysis is as follows:

Nitrogen,	1.60
Phosphoric acid,	.77

The amount of plaster was not determined. The valuation is $6.68 per ton for the phosphoric acid and nitrogen.

Linseed Meal and Castor Pomace.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by.
1080	Castor Pomace.	H. J. Baker & Bro., 215 Pearl St., New York City.	Manufacturer.	Manufacturer.
1315	R. B. Brown Oil Co's Castor Pomace.	R. B. Brown Oil Co., St. Louis, Mo.	"	"
1154	Collier's Castor Pomace.	Collier White Lead and Oil Co., St. Louis, Mo.	Olds & Whipple, Hartford.	Station Agent.
1306	St. Louis Lead and Oil Co's Castor Pomace.	St. Louis Lead and Oil Co., St. Louis, Mo.	F. Ellsworth, Hartford.	"
1081	Linseed Meal. Same as fodder CLXXIV.	....	Wilder & Puffer, Springfield, Mass.	H. H. Austin, Suffield.

Linseed Meal and Castor Pomace—Analyses and Valuations.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Potash.	Cost per Ton.	Valuation per Ton.
1080	H. J. Baker's Castor Pomace	5.33	1.68	1.06	....	$22.11
1315	R. B. Brown Oil Co's Castor Pomace	5.35	1.80	1.19	....	22.43
1154	Collier's Castor Pomace	5.68	1.99	1.16	$25.00	23.83
1306	St. Louis Lead and Oil Co's Castor Pomace	5.60	1.90	.94	24.00	23.24
1081	Linseed Meal	5.73	2.50	1.60	28.00	24.99

POTASH SALTS.

1189. Bisulphate of potash. Sold by Geo. B. Forrester, New York City. Sent by M. S. Baldwin, Naugatuck.

1181. Muriate of Potash. Sold by C. V. Mapes, New York. From stock purchased by C. H. Cables, Thomaston. Sampled by Station Agent.

1174. Muriate of Potash. From stock of H. J. Baker & Bro, New York. Sampled and sent by J. J. Webb, Hamden.

1326. Muriate of Potash. Stock of H. J. Baker & Bro. Sampled and sent by Dennis Fenn, Milford.

1255. Muriate of Potash. Stock of National Fertilizer Company, Bridgeport. Bought and sent by R. A. Moore, Kensington.

1247. Kainite. Stock of H. J. Baker & Bro. Bought and sent by J. M. Millbank, Greenfield Hill.

1183. Kainite. From Bowker Fertilizer Company, Boston, Mass. Stock of Usher & Tinker, Plainville. Purchased of them by T. N. Bishop, and sampled by Station Agent.

1187. Kainite. From H. J. Baker & Bro., New York. Stock of R. B. Bradley & Co., New Haven. Sampled by Station Agent.

1252. Kainite. From H. J. Baker & Bro., New York. Stock of R. B. Bradley & Co., New Haven. From one bag bought by the Station.

Potash Salts Analyses.

	1189	1181	1174	1326	1255	1247	1183	1187	1252
Potash guarant'd	*38.10*	....	....	*52.90*	*50.1*	....	*12.00*	....	....
Potash found......	33.87	53.78	50.22	51.59	47.65	12.47	12.12	12.12	12.71
Equiv. Sulphate ...	62.60	....	....	....	....	23.06	22.40	22.40	23.50
Equiv. Muriate	....	85.18	79.54	81.60	75.47	....	....	....	....
Cost per Ton......	*52.50	*37.50	36.50	40.00	37.00	*10.50	15.00	....	....
Potash costs per 100 lbs.	$ 8.26	3.90	3.63	3.87	4.09	4.21	6.19	....	....

* In New York.

1189 is a sample of "bisulphate of potash," stated by the purchaser to have been guaranteed "70½ per cent. test," a guarantee ambiguous in the case of a bisulphate, but which may mean 70½ per cent. of either potassium sulphate or potassium bisulphate, equivalent to 38.1 or 24.4 per cent. of actual potash.

A letter from the seller makes it clear that the former gure was the one meant in the guarantee. New York analys showed 36.65 per cent. of potash, equivalent to 67.76 per nt. of sulphate.

In Bulletin No. 78, p. 7, an analysis of the article is given showg only 33.87 per cent. of potash, or 62.6 per cent. of sulphate. nis discrepancy is accounted for by the fact that the Station ly determines and takes account of potash which is freely soluble boiling water, for the reason that the farmer in buying it requires at it should be in a readily available, hence a soluble form. This ticle contains a considerable amount of potash not readily soluble.

The full analysis is given below :

Insoluble in Acid	1.87
Iron Oxide	3.86
Lime	.37
Magnesia	.22
Potash	35.33
Soda	5.94
Sulphuric Acid	41.24
Chlorine	8.76
Water and Undetermined	2.41
	100.00

1287 and **1252** are samples of goods in stock of R. B. Brady & Co., of New Haven, stated to have been bought of H. J. Baker Bro. They were in bags plainly labeled "Double Sulphate Potash and Magnesia; 48–52 per cent., Sulph. Pot., 32–36 per ent. Sulph. Magnesia." **1252** was bought by the Station for ouble sulphate of potash and magnesia and applied to a plot of nd in the belief that it was true to the label. Subsequent amination proved that both samples were kainite and not what ey were labeled. In the bill rendered the goods were properly iarged, however, as kainite.

Potash in kainite costs considerably more than in high grade uriate, and in most cases probably the magnesia and soda salts the kainite are of no special advantage. It is used by manucturers as a source of potash in mixed goods intended to carry ut little potash, and serves at the same time as a "make-weight" bring the goods down to the quality of "cheapness" called for y customers. It is cheaper for them to use kainite, even though ctual potash costs more in it than in muriate, than to use murite and to be obliged to put in plaster or other ballast.

COTTON HULL ASHES.

Six samples of "Potash Fertilizers," in one case "said to be ashes of Cotton Seed Hulls," and in another called "Sulphate of Potash," but evidently also cotton hull ashes, have been analyzed for parties in Suffield and Warehouse Point. All of them were bought of R. E. Pinney, Suffield. The results are as follows:

	1087	1147	1112	1268	1088	1125
Soluble phosphoric acid..	1.47	2.14	1.34	.73	.25	.94
Reverted " " ..	4.18	4.72	5.59	5.88	4.40	4.69
Insoluble " " ..	.52	2.77	3.13	3.34	.51	.45
Potash soluble in water,	32.52	27.73	23.80	19.13	21.87	17.81
Potash insoluble in water,		----	1.19	2.78		
Cost per ton, ...		$39.00	39.00	39.00		39.00
Valuation, ...	$58.08	55.34	50.07	42.79	40.59	36.54

This material, as the analyses show, is not uniform in composition. The phosphoric acid varies from 5.2 per cent. to 10.0, and the potash from 17.8 to 32.5 per cent. The samples which are dark in color, **1088**, **1125** and **1268**, are inferior to those which are light gray.

The water-soluble potash is valued at 7½ cents per lb. since chlorine is not present in any considerable quantity. The potash insoluble in water is disregarded in the valuation.

Phosphoric acid is valued at 10, 9 and 4½ cents, as in superphosphates. These articles furnish potash in a cheap and desirable form for tobacco, and we understand they were used chiefly on tobacco land.

The ashes are obtained from cotton seed oil factories. The seed before pressing is hulled, and the hulls are used partly or entirely for fuel in the furnaces. The ashes are liable to be mixed with coal ashes.

WOOD ASHES.

1166. Wood ashes from house fires. Sent by D. H. Van-Hoosear, Wilton.

1297. Ashes from Merwin's brick kilns, Berlin. Sampled and sent by R. A. Moore, Kensington.

ANALYSES.	1166	1297
Phosphoric acid,	1.98	.80
Potash soluble in water,	7.51	1.42
Matters insoluble in acid,		64.80
Cost per ton,		$4.00

The poor quality of the brick kiln ashes is due chiefly to the fact that they contain so large a proportion of brick dust and sand; besides this to the fact that chestnut wood is largely used in the kilns which seems to be poorer in potash than the harder kinds.

If the brick kiln ashes could be kept from large admixture of sand and brick dust, they would be valuable to farmers in the vicinity. Poor as they are now (three-fifths sand and brick dust) they would no doubt be beneficial on many soils, but the *profitableness* of their use at $4.00 a ton would largely depend upon the cost of transportation.

HEN MANURE.

1167. Sampled and sent by D. H. VanHoosear, Wilton. The material was very dry and did not contain as large an admixture of earth as is frequently the case.

ANALYSIS.	
Phosphoric acid,	2.43
Potash,	1.59
Nitrogen as ammonia,	.36
Nitrogen of organic matter,	2.45
Cost per ton,	$12.50

Reckoning nitrogen at 20 cents per lb., potash at 4¼ cents, and phosphoric acid at 6 cents, the valuation of this article would be $15.51.

ELEPHANT'S DUNG.

1064. This article was sent by Bradley Nichols & Sons, of Bridgeport. It is purchased by them from the winter quarters of Barnum's circus in large quantities. It is understood to be the solid portion of the excrement, quite free from litter and containng probably little of the urine of the animals. For comparison are given analyses of stable manure from the stables of New York Street Railroad Companies, consisting of horse dung, urine and litter, cow manure containing no litter, and well rotted yard manure in its usual condition. The last three analyses were made by the writer in 1873, and published in the Report of the Board of Agriculture for that year.

	Elephant's Dung. 1064		Fresh Horse Manure.		Fresh Cow Manure.		Old Yard Manure.	
Water		78.79		75.76		85.30		54.70
Organic and Volatile Matters		19.63		19.17		12.66		10.87
Containing Nitrogen:								
From Ammonia	.02		.26		.07		.03	
From Organic Matters	.20		.27		.31		.43	
Total Nitrogen	.22		.53		.38		.46	
Ash containing:								
Potash	.30	1.58	.51	5.07	.36	2.04	.16	34.43
Soda	.08		.09		.04		.07	
Lime	.10		.30		.29		.47	
Magnesia	.06		.19		.19		.50	
Oxide of Iron and Alumina	.03		.19		.09		2.00	
Sulphuric Acid	.05		.09		.04		.01	
Phosphoric Acid	.13		.41		.16		.72	
Chlorine	.02		.07		.07		trace	
Sand, Clay and Insoluble	.81		3.22		.80		30.50	
		100.00		100.00		100.00		100.00

The elephant's dung represented by this sample is quite inferior to either of the samples of stable manure. This may be largely due to the fact that only the solid excrement was taken for analysis. The solid portions represent what passes through the animal undigested; the urine represents what has been assimilated from the food and has served its purpose in the animal economy. When animals are kept on a "maintenance ration;" most that is valuable in the food either as nourishment or as manure is assimilated and passes off, not through the intestines but the kidneys. It is just this valuable portion of the manure that so often is allowed to run to waste in the stable or barn yard.

The quality of manure (liquid and solid) is directly dependent on the quality of the food, being best when the food is most nutritious, and it is probable that the food of the elephants during the winter is less nutritious than that of milk cows or hard-worked horses.

DAMAGED GRAIN.

1152. A sample of grain damaged by fire and water taken from the ruins of a mill was sent to the Station by Joseph Sellers, of Gildersleeve. The analysis is as follows:

Water,	51.10
Phosphoric acid,	1.82
Nitrogen,	1.69

Such material would answer for the compost heap, but with lf its weight consisting of water, could not profitably be trans- rted far. Compare analysis with those of Stable Manure above.

PAPER MILL WASTE.

1258. A sample of this material sent by Henry Barrows, of rth Manchester, contained

Water,	5.40
Organic and volatile matter,	45.16
Ash,	49.44
	100.00

The organic matter contained 1.39 per cent. of nitrogen, and the ash were .39 per cent. of phosphoric acid, and 41.84 per nt. of sand and earth. The material is probably the refuse moved from rags before pulping them for the paper manu- ture.

MARINE MUD.

A sample of Marine Mud, **1082**, sent to the Station in Decem- er last, by W. T. Foote, of Guilford has the composition given elow. For comparison are given three other analyses. One of ew Haven harbor mud, (1860), another of mud from Saybrook, 1879), and a third of mud from Guilford, (1882).

	N. Haven Harbor.	Saybrook.	Guilford. 1882.	1082. Guilford. 1883.
Water	*Dry*	71.32	45.68	49.11
Organic and volatile matters,	10.56	2.79	4.54	3.20
Nitrogen,	(.52)	(.14)	.18	
Sand and insoluble,	77.63	20.82	40.97	33.90
Oxide of iron and alumina	7.36	2.62	6.14	3.75
Lime	.73	.26	.90	3.62
Magnesia,	.73	.51	.05	.73
Potash,	.77	.17	.36	.34
Soda,	.80	.60	.56	.83
Sulphuric acid,	.96	.39	.79	.18
Phosphoric acid,	.03	trace	trace	.68
Chlorine,	.43	.51		.91
Carbonic acid				2.93

The analysis of New Haven harbor mud was made on a dry sample and is not directly comparable with the others.

Swamp Muck.

1295. Swamp Muck, taken two feet below the surface of the swamp, sun dried.

1296. Swamp Muck, taken from same swamp as **1295**, from surface and not over two inches below the top, sun dried.

These two samples were sent by Jas. N. Bishop, Plainville.

Analyses.

The fresh material contains:	1295	1296
Water,	58.75	38.11
Organic and volatile matter,*	37.13	31.00
Ash,	4.12	30.89
	100.00	100.00
*With nitrogen,	.81	1.06
The ash contains:		
Sand and soil,	1.67	22.06
Oxide of iron, and alumina,	.63	6.41
Lime,	1.06	.80
Magnesia,	.11	.42
Phosphoric acid,	.04	.32
The dry muck contains:		
Organic and volatile matter,	89.85	49.6
Nitrogen,	1.96	1.7
Sand and soil,	4.03	35·3
Oxide of iron and alumina,	1.52	10.3
Lime,	2.56	1.3
Magnesia,	.27	0.7
Phosphoric acid,	.09	0.5

The chief difference in these mucks is that the surface muck contains a good deal of sand and earth while the lower layers are comparatively free from it.

MARL.

1059 is a sample of "Marl" sent to the Station by L. S. Wells, of New Britain. He writes, "It was taken from a sewer ditch near the High School in New Britain. The formation is as follows: Surface filling 12 inches, next peat or muck 18 inches, and below this 3 feet or more of "marl." Underneath this there is probably gravel. Has it value as a fertilizer?"

The analysis is as follows:

Water,	9.88
Insoluble in acid,	59.05
Oxide of iron and alumina,	4.95
Lime,	9.81
Magnesia,	1.07
Phosphoric acid,	trace
Carbonic acid,	7.45
Other matters by difference,	7.79
	100.00

In the organic matter of the marl was .22 per cent. nitrogen. The material has very little value as a fertilizer, except what lies in its 18 per cent. of carbonates of lime and magnesia. These ingredients would make it a useful application to most of our soils.

LAND PLASTER.

1153. Cayuga Land Plaster.* From stock of Cayuga Plaster Co., Union Springs, N. Y. Sampled by William A. Nettleton, Bridgeport, Ct. Cost $3.00 per ton in car lots.

1109. Onondaga Land Plaster. Stock of Wm. H. Earle & Co., Worcester, Mass. Sampled and sent by J. P. Barstow & Co., Norwich.

1153 contained 30.03 per cent. of sulphuric acid and 11.17 per cent. of insoluble matters.

1109 contained 34.46 per cent. of sulphuric acid and 6.05 per cent. of insoluble matters.

The composition of the samples is as follows:

	1153	1109
Hydrated sulphate of lime (gypsum),	74.09	64.56
Matters insoluble in acids,	6.05	11.17
Other matters, chiefly carbonate of lime,	19.86	24.27
	100.00	100.00

POLLARD'S SPECIAL FERTILIZERS.

Four samples of these special manures have been analyz during the year.

They are not tabulated with the others on page 54, becau any fertilizers bearing the name of Pollard have in this State special savor of their own which forbids their being ranked wi those of any other manufacturer.

The following with regard to him and them is reprinted fro the last Station Bulletin:

The first work of this Station on its establishment in 1877 w to analyze two samples of Pollard's Fertilizers, sold by "H. Pollard, Agricultural Chemist," and made by "Pollard Bros." New Haven, from harbor mud. The goods were a little mo valuable agriculturally, and decidedly less valuable commercial than the barrels in which they were put up. The results of t analyses were published and Mr. Pollard went elsewhere.

In the Station Report for 1880, p. 26, is some further account his operations and an analysis of "Pollard's Concentrated Pri Guano," brought to the Station by a person who gave his nan and address as F. C. Cook, 119 Ellsworth ave., New Haven, b who probably was H. M. Pollard, and who said he had purchas ten tons of the material. A sample of it was made up of nitrat and phosphates of potash, soda and ammonia flavored with nig soil. It could not be sold with any profit to the maker or co pounder for much less than $130 per ton, but was said to ha been bought for $65.00.

The right to manufacture this fertilizer was afterwards sold, offered for sale, at several places in Pennsylvania for $500 by t enterprising originator. The analysis made at this Station w shown and it was asserted that this Concentrated Privy Gua could be made for $13.56 per ton.

Last August the Station analyzed four samples of "Pollard Special Fertilizers," sent by the *New England Homestead*, bei samples got by them of the Perry Oil Co., Pawtucket, R. I., wi whom "Prof." H. M. Pollard, the "Agricultural Chemist," ha an office at that time.

The analyses and valuations are as follows:

POLLARD SPECIAL FERTILIZERS.

	Top Dressing.	For Corn.	For Potatoes.	For Cabbage.
Station No.	**1278**	**1279**	**1280**	**1281**
Nitrogen as ammonia	3.11	2.71	2.16	3.03
Nitrogen of organic matter,	2.63			
Soluble phosphoric acid,	.96	.59	.35	.43
Reverted phosphoric acid,	3.03	4.09	4.02	3.85
Insoluble phosphoric acid,	2.31	6.07	6.57	5.41
Potash,	6.48	6.26	5.83	5.45
Cost,	$50.00	50.00	50.00	50.00
Valuation,	$39.15	31.24	28.31	30.60
The guarantees were:				
Ammonia,	3½	3½	3	4
Phosphoric acid,	5	8¼	7½	8¼
Potash,	4	5¼	8	5½

The cost of these goods was $50.00, the average valuation 32.32; difference $17.68 per ton, or 54.7 per cent. of the valation.

This is more than double the average difference between the ost and valuation of the superphosphates analyzed this year, or our times the average difference between the cost and valuation f the special manures.

According to the *N. E. Homestead*, Pollard has been operating ately in Rhode Island and Southeastern Massachusetts; "analyzg" soils and prescribing for them at the very modest price of 0 cents per acre. The reason for again referring to the man is o warn Connecticut farmers against him. His effrontery is oundless and it would not be at all surprising if he should before great while begin his swindling operations in this State again—nd practice for a time successfully. "Prof." H. M. Pollard, Dr." Pollard, or "Prof. Geo. H. Stockbridge," "Agricultural hemist," "State Chemist to Rhode Island and afterwards to lassachusetts," "not Prof. Stockbridge of the Massachusetts gricultural College," but "another Stockbridge," sometimes "a rother," sometimes "a nephew," but always the same ubiquitous ollard, is described as a man "62 years old, 5 feet 7½ inches in eight, weighs about 180 pounds, has a light complexion, light yes, sandy gray whiskers and gray hair."

The *New England Homestead* of Sept. 6, 1884, contains a full nd entertaining account of the operations of this persistent and icturesque swindler.

REVIEW OF THE FERTILIZER MARKET.

ORGANIC NITROGEN.

In Dried Blood, at wholesale, nitrogen was quoted in the Nev York market during December, 1883, at about 14.4 cents pe pound, which was the highest figure for the year. It fell in Januar of this year to 12.9 cents, rallied somewhat, and in May and Jun was quoted at 14 and 13.9 cents per pound. It again fell, sellin in November at 12.4 cents.

In Azotin,* *at wholesale*, nitrogen was quoted in the New Yorl market at 17.0 cents in December, 1883. It fell to 13.2 cents i January 1884, rose to 13.9 cents in May and fell steadily to 12. in November.

Dry Ground Fish Scrap, at wholesale, was quoted in Nev York at $25.50 per ton in December, 1883. It fell to $23.90 i March, rose to $24.75 in May, and since then has fallen quit steadily to $23.00 in November.

The average composition of Fish Scrap, as determined in nin analyses, made during the year in Massachusetts, New Jersey an Connecticut is, nitrogen 8.37 per cent., phosphoric acid 7.61 pe cent. Now, if we take 4.8 cents per pound as the wholesale cos of phosphoric acid in fish (6 cents, the retail price, less 20 pe cent.), we may reckon *approximately* the wholesale cost of nitro gen in Fish Scrap as follows:

10.8 cents per pound in December, 1883, falling to 9.9 cents i March, rising to 10.4 in May, and since then falling steadily t 9.3 in November.

The retail cost of organic nitrogen at New York and Philade phia factories during the last season has been about as follows:

In dried blood, 4 samples,	18.3	cents	per lb.
In ammonite and tankage, 4 samples.	15.8	"	"
In dry ground fish,‡ 2 samples,	12.5	"	"
In castor pomace,‡ 1 sample,	20.2	"	"

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* Azotin and Ammonite are trade names for animal matter (meat scrap, crack lings) very dry and free from grease.

† Bull. N. J. Ag'l Exp't Station, XXXIV., p. 5.

‡ Valuing phosphoric acid at 6 cents per pound.

The retail cost in the Connecticut market during the season has been:

In dry ground fish,[†] 4 samples,	18.3 cents per lb.
In castor pomace,[†] 2 samples,	19.7 " "

The average *wholesale* cost of nitrogen in dried blood, azotin, and fish scrap, for the last year, has been about 12.4 cents per pound in New York.

The average *retail* cost of nitrogen in the same goods at New York and Philadelphia, has probably been about 16.2 cents or 30 per cent. above the wholesale rates.

The average *wholesale* cost of nitrogen in blood and azotin alone has been 13.6 cents; average *retail* cost of same 17 cents, or 25 per cent. advance on wholesale rates.

NITROGEN OF AMMONIA SALTS.

At wholesale in New York, nitrogen was quoted at 16.4 cents per pound in December and January last, which were the highest figures for the year. It fell to 14.6 cents in April, rallied to 15.3 cents in May, and did not vary much from 14.8 cents till November, when it was quoted at 15.2.

At retail the average price of nitrogen in New York and Philadelphia appears to have been about 17.1 cents per pound during the season, varying from 19.2 cents to 15.5 cents.[*]

In the Connecticut market it has sold for 15.8 cents per pound, being the cheapest form of available nitrogen for sale in this State during the season.

The average wholesale cost of nitrogen in sulphate of ammonia for the last twelve months has been about 15 cents per pound.

The average retail cost has been about 16.8 cents per pound or 12 per cent. advance on the wholesale price.

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[*] Bull. N. J. Ag'l Exp't Station, XXXIV., p. 5.

[†] Valuing phosphoric acid at 6 cents per pound.

NITROGEN OF NITRATE OF SODA.

At wholesale in New York nitrogen was quoted in December, 1883, at 15.2 cents per pound. It fell in January to 14.8 cents, in February to 14.3 cents, and has not varied very much from that figure through the year.

At retail, in New York and Philadelphia markets during the season it has sold for from 18.9 cents to 15.5 cents; average 16.9 cents per pound.

At retail in this State, nitrogen of nitrate of soda has cost from 19.1 cents to 16.5 cents per pound; averaging 16.7 cents.

The average wholesale cost of nitrogen in nitrate of soda has been about 14.3 cents per pound during the year.

The average retail cost has been about 17.1 cents per pound, or 19.5 per cent. advance on the wholesale rates.

PHOSPHATIC MATERIALS.

Refuse Bone Black, which in December, 1883, was quoted at $22.50 per ton wholesale in New York, declined in February of this year to $22.00. In May it was quoted at $21.50, in June $20.37, in July and August $21.75, then fell to $16.50 in October, where it remained in November.

Ground Bone remained steady at $31.50 per ton till July, fell to $30.50 in August, and since then has been quoted at $29.00.

Charleston Rock, f. o. b. in New York, quoted in December of last year at $8.50 per ton, remained steady till April. In May it was quoted at $8.75, and has held that price ever since.

Sulphuric Acid 66° quoted at 1⅜ cents per pound in December 1883, fell to 1¼ in February, and since July has averaged a shade lower (1.22).

The above are wholesale quotations. If we assume that soluble, reverted and insoluble phosphoric acid have commercial values which stand in the ratio of 10, 9, and 2½, as is assumed in our valuations, then the New York *retail cost* of soluble phosphoric acid bought direct of manufacturers, as shown in analyses reported by the New Jersey Station, has been on the average:

In bone black superphosphates,	7.3 cents per lb
In South Carolina rock superphosphates,	8.6 " "

In Connecticut markets the retail cost of soluble phosphoric acid has averaged 9.2 cents per pound, the extremes being 7.5 cents and 10.5 cents.

ACTUAL POTASH.

In Muriate of Potash.

At wholesale in New York potash in muriate was quoted in December, 1883, at 3.22 cents per pound. It rose in May to 3.44 and since then has ruled quite steadily at 3.38 cents per pound. The average price for the year has been about 3.3 cents.

At retail in New York and Philadelphia it has cost on the average about 3.7 cents, and in Connecticut 3.87 cents per pound, or 17.3 per cent. advance on the average wholesale quotation for the year.

In Kainite.

At wholesale in New York kainite was quoted in December, 1883, at $8.65 per ton. It fell steadily till April, when it cost $7.13 per ton. It rallied to $7.83 in July, and fell again in August to $7.50, in September to $7.00, and in November to $6.38.

The average price for the year has been about $7.57 per ton.

Kainite varies somewhat in composition. Assuming 12.2 per cent. of actual potash as its average content, the above quotations may be expressed in cost of actual potash, as follows:

At wholesale in New York actual potash in kainite cost 3.5 cents per pound in December, 1883. It fell steadily till April, when it cost 2.9 cents per pound. It rallied to 3.2 cents in July, and fell again in November to 2.5 cents per pound.

The average wholesale price for the year has been about 3.1 cents per pound.

At retail in New York and Philadelphia potash in kainite has cost about 4 cents per pound. In the two samples here analyzed it has cost 4.21 cents and 6.19 cents per pound.

To recapitulate, nitrogen has fallen during the year considerably. Phosphatic materials are lower, with the exception of South Carolina rock, which is a little higher than a year ago. Sulphuric acid is a shade lower and potash is a little higher.

The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged, and this average is taken as the quotation for the month.

There is a field here which might be profitably occupied by our agricultural papers, in securing *trustworthy* wholesale and retail quotations of fertilizers and fertilizing chemicals from the Boston, New York and Philadelphia markets and arranging them in a way which could be readily understood.

The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

Phosphate rock, *kainite*, *bone*, *fish scrap*, *tankage*, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by an analysis at the time of purchase.

Sulphate of ammonia, *nitrate of soda and muriate of potash* are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, *azotin and ammonite* are quoted at so much "per unit of ammonia." A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of dried blood has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $2.25 per unit, a ton of it will cost 8½×2.25=19.13.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given:

Ammonia at	$4.00	per unit	is equivalent to	nitrogen at	24.3	cts.	per lb.
"	3.90	"	"	"	23.7	"	"
"	3.80	"	"	"	23.0	"	"
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.2	"	"
"	2.90	"	"	"	17.6	"	"
"	2.80	"	"	"	17.0	"	"
"	2.70	"	"	"	16.4	"	"
"	2.60	"	"	"	15.8	"	"
"	2.50	"	"	"	15.2	"	"
"	2.40	"	"	"	14.6	"	"
"	2.30	"	"	"	14.0	"	"
"	2.20	"	"	"	13.4	"	"
"	2.10	"	"	"	12.8	"	"
"	2.00	"	"	"	12.2	"	"

Commercial sulphate of ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	5	cents per lb.	Nitrogen	costs	24.4	cents per lb.
"	4⅞	"	"	"	23.7	"
"	4¾	"	"	"	23.1	"
"	4⅝	"	"	"	22.5	"
"	4½	"	"	"	21.9	"
"	4⅜	"	"	"	21.3	"
"	4¼	"	"	"	20.7	"
"	4⅛	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	3⅞	"	"	"	18.9	"
"	3¾	"	"	"	18.3	"
"	3⅝	"	"	"	17.6	"
"	3½	"	"	"	17.0	"
"	3⅜	"	"	"	16.4	"
"	3¼	"	"	"	15.8	"
"	3⅛	"	"	"	15.2	"
"	3	"	"	"	14.6	"

Commercial nitrate of soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	3⅝	cents per lb.	Nitrogen	costs	23.2	cents per lb.
"	3½	"	"	"	22.3	"
"	3⅜	"	"	"	21.5	"
"	3¼	"	"	"	20.8	"
"	3⅛	"	"	"	19.9	"
"	3	"	"	"	19.2	"
"	2⅞	"	"	"	18.3	"
"	2¾	"	"	"	17.6	"
"	2⅝	"	"	"	16.9	"
"	2½	"	"	"	16.0	"
"	2⅜	"	"	"	15.2	"
"	2¼	"	"	"	14.4	"
"	2⅛	"	"	"	13.6	"
"	2	"	"	"	12.8	"

Commercial muriate of potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

If quoted at	2.00	cts. per lb.	Actual potash	costs	3.96	cts. per lb.
"	1.95	"	"	"	3.86	"
"	1.90	"	"	"	3.76	"
"	1.85	"	"	"	3.66	"
"	1.80	"	"	"	3.56	"
"	1.75	"	"	"	3.46	"
"	1.70	"	"	"	3.36	"
"	1.65	"	"	"	3.26	"
"	1.60	"	"	"	3.16	"
"	1.55	"	"	"	3.06	"
"	1.50	"	"	"	2.96	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since May, 1881. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt. For three months azotin and ammonite were not quoted at all.

		COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH AT WHOLESALE IN
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1881.	May	21.3	21.8	21.9	24.7	3.78
	June	21.5	21.8	21.1	24.8	3.86
	July	22.0	21.8	20.8	25.6	3.92
	August	22.4	22.1	20.8	25.2	4.06
	September	23.8		20.9	24.7	3.78
	October	23.0	24.3	20.8	24.9	3.64
	November	23.3	24.3	20.4	25.6	3.62
	December	23.1		20.3	25.7	3.60
1882.	January	23.0		19.9	25.6	3.71
	February	22.3	22.2	19.8	25.6	3.60
	March	19.6	20.1	18.3	25.0	3.36
	April	19.7	19.7	18.4	23.8	3.24
	May	19.1	19.7	18.3	22.7	3.26
	June	18.9	19.7	16.9	22.4	3.28
	July	19.8	19.5	16.8	22.4	3.40
	August	19.5	19.5	16.8	22.4	3.52
	September	19.7	20.3	17.7	22.4	3.60
	October	19.7	20.1	17.8	22.3	3.56
	November	19.7	20.0	17.6	22.2	3.56
	December	19.7	20.1	17.6	21.8	3.58
1883.	January	19.7	20.1	17.9	20.7	3.51
	February	19.4	19.7	17.9	21.9	3.42
	March	18.0	18.9	17.8	20.7	3.42
	April	18.2	18.9	17.9	20.1	3.40
	May	18.2	18.9	16.3	20.1	3.34
	June	17.8	18.9	16.3	20.0	3.36
	July	17.2	18.9	15.6	19.0	3.23
	August	16.0	18.9	15.3	18.6	3.18
	September	15.3	17.0	14.8	17.6	3.21
	October	15.0	15.2	14.8	17.3	3.12
	November	14.5	15.2	15.2	16.4	3.20
	December	14.4	17.0	15.2	16.4	3.22
1884.	January	12.9	13.2	14.8	16.4	3.28
	February	13.2	13.7	14.3	15.0	3.23
	March	13.6	13.7	14.2	14.6	3.34
	April	13.6	13.6	14.0	14.6	3.38
	May	14.0	13.9	14.4	15.3	3.44
	June	13.9	13.5	13,8	14.6	3.36
	July	13.2	13.5	14.2	14.9	3.37
	August	13.6	13.3	14.3	14.7	3.36
	September	12·8	13.3	14.4	14.4	3.28
	October	12.9	13.2	14.3	14.8	3.38
	November	12.4	12.6	14.4	15.2	3.26

ANSWERS TO CORRESPONDENTS WITH REGARD TO FERTILIZERS, ETC.

Value of Gas Lime.

Gas Lime is not constant in composition. Applied, fresh from the works, even in small quantity it is deadly to plants. It is made harmless by long weathering or composting, but if weathered would probably lose largely or entirely its special value as an insecticide. It is reported in agricultural papers that when dried and powdered it has been used with good effect on turnips and beets to keep off insect pests, being sprinkled on them like Paris green. Some insect pests are destroyed by proper use of any fine powder.

If you wish to try it as a fertilizer on a small plot, it should be applied very early in spring or late in the fall at the rate of say fifty bushels per acre. Slacked lime is a safer source of lime.

CAUSES OF FAILURE IN USE OF FERTILIZERS.

A correspondent writes:

"Last fall in sowing my crop of spinach I used in addition to other manures, some of the —— tobacco manure, sowing it in the drill and leaving occasionally a row without fertilizing. Up to the closing in of winter the crop had made a good growth but there was not the least perceptible difference in the fertilized and unfertilized plots, and now the question has arisen, where was the difficulty? I am sure that the land was not so rich, but that a judicious application of a good fertilizer must have had some effect everything else being favorable. . . . It would seem as if an application of 500 to 600 pounds per acre applied in close contact to the roots as it would be, being sowed in the drill, should make a perceptible difference, and perhaps an analysis of this sample will throw some light upon the subject."

The fertilizer referred to in this letter was analyzed, and though somewhat below the guaranteed composition, could not be called a very inferior fertilizer.

The reply was as follows:—

"The question why the fertilizer had no perceptible effect on the crop would be difficult to answer without knowing many conditions with regard to the soil and manner of application, which it is very difficult to ascertain. If the soil for that crop needed either phosphoric acid, nitrogen or potash this fertilizer supplied them. If the fertilizer was applied too heavily or too near the roots it might have damaged the crop, particularly if the soil was dry. Sometimes this damage is evident to the eye, sometimes it is only enough to neutralize the good effect of the manure, so that apparently the manure produces no effect at all.

Sometimes, no doubt, what the soil needs is tillage; lightening or making it more compact, and in such cases no amount of manure will help much until there has been thorough tillage of the land."

It may be added here that the full effect of high manuring can only be got with the coöperation of the prolonged high temperature and strong light of summer weather. Cold and dark seasons largely neutralize the effect of all manures.

THE SUPPLY OF LIME FOR THE TOBACCO CROP.

Gypsum or Stone Lime.

In answer to a letter on this subject was written:

Gypsum is thought to be favorable to the "burning quality" of tobacco, *i. e.,* it tends to make the ash burn white. This is the result of observation, and it goes to show that the tobacco plant is able to supply itself with lime from plaster, although in so doing the lime must be separated from the sulphuric acid with which, in plaster, it is united.

If it seems desirable to substitute plaster for lime the relative quantity of the former to use is easily calculated from the statement that 56 pounds of good fresh-burned stone lime contain as much lime as 202 pounds of good unburned plaster.

I do not think, however, that it would be generally profitable to substitute plaster for lime, because, as you will see on referring to my examinations of tobacco, published in the Report of the Board of Agriculture for 1872,* the average amount of sulphuric acid reckoned to be contained in the crop of an acre of tobacco was 17 pounds, and that of lime 88 pounds.

In the amount of plaster that will supply 17 pounds of sulphuric acid there are 11.9 pounds of lime, and in the quantity of plaster which can yield 88 pounds of lime there are 126 pounds of sulphuric acid.

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* See also this Report, page 96 *et seq.*

If the tobacco crop of an acre is obliged to supply itself with lime from plaster alone, this 126 pounds of sulphuric acid must be disposed of. The only way this can be done without liability of injuring the crop is by having some substance in the soil with which it can unite at once to form an inert compound. If other sulphates, such as potash, are present in the soil, or have been applied as fertilizers, their sulphuric acid will be separated in the same manner, in a degree proportional to their service in nourishing the crop, and if muriates or phosphates are on hand, their acids are likely to accumulate in the soil, because the tobacco plant takes up from all of them the alkali or base much more abundantly than the acid.

Now, *lime* applied as carbonate (or shortly becoming carbonate if supplied as slacked lime) is the cheapest, safest, and on all accounts best material to have in contact with the roots, to neutralize any acids which may become free in the soil when the plant withdraws from them the alkalies or bases they were associated with. The liberation of strong acids like sulphuric and muriatic acids in the soil, of course goes on slowly, and they are vastly diluted, and some small quantities of them may exist there without detriment.

It is, however, pretty certain that there is a liability to injury from this cause, and it is safer to avoid such liability. Again, lime as carbonate favors the conversion of the nitrogen of inert vegetable matter into nitrates, is a cheap accessory means of supplying this element, and therefore is a substitute in some degree for the costly nitrogenous fertilizers which are now so largely used. I should advise to supply to tobacco land no more than enough plaster to provide the crop with sulphur. 100 pounds of good Nova Scotia plaster, containing about 45 pounds sulphuric acid (anhydrous), 32 of lime and 22 of water, etc., will probably be enough.

If superphosphates or "specials" are used they will supply abundance or superabundance of plaster, since sulphate of lime is usually a necessary accompaniment of soluble phosphoric acid.

In such cases plaster in addition would be of no use whatever.

If sulphate of potash be used, I should apply no plaster but use with it the above amount of lime.

Especial pains should be taken to avoid all muriates or chlorine compounds.

WHAT IS KIESERITE?

Kieserite is impure magnesium sulphate or Epsom salts, one of the products of the salt mines of Stassfurt, in Germany. The crude Kieserite often contains 30 per cent. or more of water, and may have considerable magnesium chloride—a compound injurious to plants if applied in any considerable quantity to them. "Calcined Kieserite" is that which has been partially freed from chlorine by heating strongly.

A recent analysis made at the Massachusetts Experiment Station showed 48.6 per cent. of magnesium sulphate (dry Epsom salts), 2.2 per cent. magnesium chloride, and the rest, 49.2 per cent., water and insoluble matter.

COMPLETE ANALYSIS OF A FERTILIZER.

Mr. S. A. Smith, when sending Sample No. **1264,** writes: "The analysis on the bag tells that there is:

Ammonia,	3 to 4½	per cent.
Available phosphoric acid,	10 to 12	"
Potash,	2 to 3	"
	15 to 19½	

Now, I should like to know what the other 80½ to 85 per cent. is composed of."

The full analysis of the sample in question is:

Potash,	3.00
Soda,	5.90
Lime,	15.17
Magnesia,	.81
Phosphoric acid,	10.95
Sulphuric acid,	21.59
Chlorine,	3.86
Sand or clay, insoluble in acid,	.65
Moisture,	14.09
Organic and volatile matters,	23.98
	100.00

With the organic (vegetable and animal substances destroyed by heat) and volatile matters are included 2.44 per cent. of nitrogen; 1.98 per cent. of this is present in the form of ammonia combined in the fertilizer with sulphuric acid.

The soda, chlorine and perhaps the magnesia, principally came from the kainite (?) used as a source of potash.

The lime, phosphoric acid and insoluble matters principally came from the phosphatic material employed. The sulphuric acid was introduced to "cut" the phosphate and make it readily soluble, which it does by combining with the lime and so setting phosphoric acid free, or causing it to form a soluble phosphate. A portion of the sulphuric acid, about 5.00 per cent. comes from the sulphate of ammonia, used to supply nitrogen or to "ammoniate" the goods.

The moisture comes in part from the water in the crude materials used, and in part from water unavoidably introduced in the process of manufacture.

On Sampling Fertilizers for Analysis.

The most difficult and critical part of the examination of a lot of any fertilizer or fertilizing chemical is the drawing and preparation of a sample for analysis.

Only in certain rare cases will it do to assume that one part of a heap or cargo of goods in bulk is like the rest, or that one package is like the others lying by it or that portions taken at the top or bottom of a single bag or barrel, have the same composition as the other portions. In a cargo or heap very great variations in the amount of moisture present are sure to be found in different parts of the lot, to say nothing of other sources of difference; and it is useless to hope for a sample that will be fairly representative unless the whole lot is overhauled, and from every car or barrow load removed, a small amount, say $\frac{1}{100}$, is taken, put in a place where it cannot lose or gain water, and finally, after thorough mixing, a portion of this large sample is separated, by a similar method substantially, for analysis.

In a lot of manufactured goods no two packages are absolutely alike. It is difficult in the manufacture of fertilizers to secure perfect mixing, especially when high grade articles are employed. For instance, 3 per cent. of potash may be introduced by adding 120 pounds of high grade muriate of potash to 1880 pounds of other material. The bulk of this amount of a heavy salt is so small that the chances of perfect mixing are much less than if the same amount of actual potash were contained in, say 600 or 1,000 pounds of material. So that no two samples drawn from different bags can be expected to be precisely alike.

There is also likely to be a difference, depending on the amount of moisture present. One bag may have been filled from the surface of a large heap which has lain a few days in dry air and has dried out a good deal on the surface; the next bag may be from the center of the same heap, which is considerably damper.

The bags which have lain on the damp floor of a retailer's storehouse (in a number of cases Agents of the Station have found them lying on the ground which was noticeably moist) will not show as good results on analysis as those lying on the top tier, exposed to dry air.

Supposing that no valuable material has gone out of the bag and only moisture has gone in, a chemical analysis will yet show the goods inferior, for no account is taken of the extra weight in the packages caused by the water.

It is then advisable in drawing a sample to take from a number of bags or barrels instead of from one, and to select the bags with some care from different parts of the lot.

Further than this, it is evident there may be considerable differences in the composition of the several portions of even a single package. A barrel of bone, for instance, requires only a little shaking, such as it gets by transportation, to bring the coarser particles to the top and the finer underneath; so that a double handful taken from either end may misrepresent the quality of the goods.

In the case of articles of fine and uniform grain, superphosphates, etc., the chief danger is of another sort, namely: that the portions next the bagging, the *surface* of the goods, will be wetter or drier than the deeper interior layers, according as the the atmosphere is wet or dry. Some kinds of goods, moreover, attract and bind water chemically, and in moist air these will be quite wet on the surface, while the interior is much dryer. They will at times absorb so much water as to dissolve partially and soak out of the bags.

These considerations go to show that the proper sampling of fertilizers is no very simple thing. It requires good judgment and a knowledge of the errors to be avoided.

The Station Agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one. The contents of bags or barrels are rapidly and accurately sampled by means of a sampler consisting of two brass tubes about three feet long—one fitted within the other. The inner tube has a handle at one end. The outer tube at the other end carries a point of solid metal. A slit three-quarters of an inch wide runs nearly the entire length of both tubes. The package is laid on its side, so that the sampler can be pushed into it *diagonally* and *horizontally* from top to bottom. The inner tube is then turned so that the slits in the two tubes coincide, the fertilizer falls in and fills the inner tube, which is then closed and withdrawn.

By this means a section of the contents is obtained which fairly represents the whole package.

A single observation has been made of the variations likely to occur in the contents of different bags when sampled with care in the way described.

Ten bags were selected from a lot of Mapes' Special Manure for Heavy Soils, at the Hartford warehouse, and sampled as above. The samples were immediately bottled and analyzed. The material was fine and apparently well mixed.

The mechanical analyses of four samples will indicate their fineness and uniformity.

	1113	1115	1117	1119
Finer than $\frac{1}{50}$ inch,	55.9	56.3	50.4	57.1
Between $\frac{1}{50}$ and $\frac{1}{25}$ inch,	23.4	23.3	25.3	25.9
Between $\frac{1}{25}$ and $\frac{1}{12}$ inch,	18.8	17.6	21.7	16.1
Between $\frac{1}{12}$ and $\frac{1}{6}$ inch,	1.9	2.8	2.6	0.9
	100.0	100.0	100.0	100.0

Here follows the partial chemical analyses and average composition.

Station No.	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	Av.
Nitrogen in Ammonia,	3.41	3.51	3.62	3.40	3.51	3.42	3.64	3.47	3.38	3.55	3.49
Nitrogen in Nitrates,	.70	.68	.71	.68	.74	.67	.74	.73	.70	.72	.71
Phos. Acid,	13.31	13.15	12.80	13.09	12.99	13.12	12.42	13.18	13.25	12.74	13.02
Potash,	3.62	3.58	4.19	3.50	3.87	3.48	4.02	3.96	3.46	4.04	3.66
Water,	11.40	11.60	11.00	11.40	11.00	11.80	11.00	11.50	11.90	11.20	11.38

The greatest difference in nitrogen (sum of nitrogen of ammonia and nitrates), between any two bags was .30 per cent.; in phosphoric acid, the greatest difference was .73 per cent.; in potash .73 per cent. The greatest difference in valuation occasioned by difference in the chemical analyses of single bags would be about $1.50 per ton, and in any combination of 3 bags, the differences would be very trifling. Such are the variations to be expected under the most favorable circumstances when the goods are very fine and well mixed and the sampling done with the greatest care.

ANALYSES OF THE ASH OF HEALTHY AND DISEASED PEACH WOOD.

P. M. Augur, Esq., the State Pomologist, recently sent to the Station for examination two samples of wood marked,

I. "From Mt. Rose peach tree supposed to be healthy."

II. "From diseased Mt. Rose peach tree."

The disease from which II was suffering was stated to be the "Yellows."

For analysis twigs of equal size were selected from the two lots. They were about $\frac{5}{16}$ inch diameter at the butt end and $\frac{3}{16}$ to $\frac{4}{16}$ inch diameter at the tip and were of last year's growth.

The pure ash of I (carbonic acid, coal and water excluded) amounted to 1.87 per cent. The pure ash of II amounted to 1.61 per cent. The analyses of 100 parts of the ashes are as follows:—

	I. *Healthy.*	II. *Diseased.*
Silica and matters insoluble in acid,	5.38	9.47
Oxide of iron,	1.09	2.09
Lime,	54.20	54.05
Magnesia,	9.49	7.49
Potash,	16.31	13.95
Soda,	1.18	1.19
Phosphoric acid,	4.34	4.68
Sulphuric acid,	6.90	6.53
Chlorine,	.46	.43
	99.35	99.88

In comparing the above analyses we note that the ash of diseased twigs contains:—

4.09 per cent. more silica, etc.,
1.00 per cent. more oxide of iron,
.34 per cent. more phosphoric acid,
.15 per cent. less lime,
2.00 per cent. less magnesia,
2.36 per cent. less potash and
.37 per cent. less sulphuric acid

than the ash of healthy twigs.

Dr. Goessmann, in his analyses of Crawford's Early Peach,* reported in the ash of branches diseased by Yellows

0.93 per cent. more oxide of iron,
9.71 per cent. more lime,
2.70 per cent. more magnesia,
3.00 per cent. less phosphoric acid and
10.34 per cent. less potash

than in ash of healthy branches, taken from a once slightly affected tree which had been restored by treating (for three years?) "with a phosphatic fertilizer in the usual proportion adding at the same time from three to four pounds of muriate of potash for every tree, the diseased branches," at the outset, having been "cut back to healthy wood." Dr. Goessmann infers that "the diseased objects (wood and fruit) contain less potash and more lime than the healthy ones."

Dr. Goessman leaves out of the account the items, Silica and matters insoluble in acid, Soda, Sulphuric acid and Chlorine, which in the above analyses amount to 13.92 per cent. of the ash of the healthy twigs and 17.62 per cent. of the ash of the diseased twigs. To omit those would somewhat increase the differences between the ash of the two, and would make lime in the ash of diseased twigs 3 per cent. more than in the healthy ones.

A more correct comparison is that of the absolute quantities of the several ash-ingredients contained in the same amount of the fresh twigs, as follows:—

In 10,000 parts of the peach twigs from Mr. Augur there are:

	Healthy	*Diseased.*
Silica and insoluble,	10.07	15.25
Oxide of iron,	2.04	3.36
Lime,	101.44	86.99
Magnesia,	17.75	12.05
Potash,	30.55	22.45
Soda,	2.20	1.91
Phosphoric acid,	8.14	7.53
Sulphuric acid,	12.91	10.51
Chlorine,	0.87	.70
	185.97	160.75

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* Paper read before Mass. Hort. Society, March 18, 1882.

Here it becomes manifest that in the peach wood here examined 10,000 pounds of diseased twigs contain

5.2 pounds more silica,
1.3 pounds more oxide of iron,
14.5 pounds less lime,
5.7 pounds less magnesia,
8.1 pounds less potash,
0.3 pounds less soda,
0.6 pounds less phosphoric acid,
2.4 pounds less sulphuric acid and
.2 pounds less chlorine

than the healthy twigs.. The diseased twigs in this case thus manifest, as compared with healthy ones, a *poverty of all the ash-ingredients*, the first two alone excepted.

The ingredients most largely deficient, and those therefore whose supply to the soil by way of fertilizing applications is most imperative, are lime, potash, magnesia and sulphuric acid.

To judge from the relative quantities of the deficient ingredients, the application of lime and magnesia in the case of Mr. Augur's peach orchard is as essential to the production of healthy wood and fruit as the addition of potash, and more necessary than the application of a phosphatic fertilizer.

The investigations of Drs. Gœssmann and Penhallow indicate that chlorine, though present in the wood in very small quantity, is yet important in the foliage as a means of assisting the transfer of nutritive matters from the leaves to the fruit and buds, and therefore must not be deficient in the soil, although evidently no large amount is needful.

Fertilizing Swamp-Muck Land.

A correspondent writes:—

"I have on my farm some twenty acres of swamp-muck land, the muck ranging from three to eight or ten feet deep. I have drained it, and part of it (some four or five acres) has been seeded down and mowed for three or four years, but the grass soon runs out. The piece where the muck is deepest I have now plowed and am about to seed it to grass again. I have a quantity of stable manure that I was thinking of putting on and harrowing in; but it has been suggested to me that perhaps I had better put on some other kind of fertilizer and use the stable manure on my upland.

"I want your advice, what to put on to bring good crops o grass—whether to use the stable manure there, or what to use instead of it. Any suggestions you may give me in regard to fertilizing that muck ground will be very thankfully received."

Answer.—Some varieties of swamp muck are nearly destitute o all kinds of plant-food except nitrogen, and contain this element in a very unavailable form. To make them fertile they require frequent applications of mineral fertilizers or else to be "amended" by dressing with large quantities of earth, marl, leached ashes, coal-ashes, or the like.

Stable manure is likely to be more profitable on the upland. Application of slacked lime at the rate of 10 to 25 bushels pe acre and of some kind of phosphatic guano such as "Orchilla" or "Curaçao" guano 100 to 200 lbs., together with 100 lbs. o "sulphate of magnesia and potash," would supply the deficiencies that probably exist. Instead of Orchilla or Curaçao Guano, 200 to 300 lbs. of fine ground South Carolina Rock Phosphate might be used.

Lime should be applied some week or two before seeding. All the materials might be applied at the same time or they may be broadcast separately as convenient.

It is not easy to give entirely trustworthy advice in this case, but from knowledge of the character of muck in Connecticut, I should recommend the lime, etc., as likely to answer your purposes.

The cheapest lime to be had will serve, provided it slacks to a fine powder, or is a fine powder so as to admit of distributing evenly.

ANALYSES OF TOBACCO LEAF.

In response to the inquiries of Mr. H. H. Austin, of Suffield, the following analyses of various samples of tobacco leaf were made with especial reference to the connection between their ash-composition and burning quality, and to the question what Soil and Fertilizers are adapted to produce good "Wrappers."

The SAMPLES were all supplied by Mr. Austin, who is responsible for such description of them as follows:

The samples 1 to 8 inclusive were the stripped leaves as used for cigar wrappers. Of these, five had undergone the sweating process, three were unsweated. The growths of Cuba, Sumatra, Wisconsin and Connecticut are represented.

Particulars follow:

The "quality" refers to all the characters that give value to wrappers, including color, texture and mode of burning.

No. 1. Havana leaf from Cuba (sweated). Good quality, burns white.

No. 2. Sumatra leaf (sweated). Burns well, poor quality otherwise.

No. 3. Wisconsin leaf, Havana seed (sweated). Quality fair, burns white and free.

No. 4. Connecticut seed leaf (sweated). Raised on new land with barn yard manure and no commercial fertilizer. Good quality, burns well.

No. 5. Connecticut leaf, Havana seed (unsweated). Manured with Cotton seed ashes, 1 ton Cotton seed meal, 300 lbs. lime, 300 lbs. plaster. Quality very good.

No. 6. Connecticut leaf, Havana seed (unsweated). Manured with 400 lbs. bone; 500 lbs. double sulphate potash and magnesia; 1 ton cotton seed meal; 300 lbs. lime and 300 lbs. plaster to the acre. Quality very good.

No. 7. Connecticut leaf, Havana seed (unsweated). Raised on stable manure, at least 10 cords to acre. Quality fair except that it crusts in burning.

No. 8. Connecticut leaf, Havana seed (sweated). Raised on good loamy land with slaughter-house manure worked over by pigs. Poor quality, crusts badly and will not burn well.

ANALYSES OF TOBACCO LEAF.—TABLE I.

	Weight of sample analyzed. Grams.	Per cent. of water in samples.	Dry weight of samples.	Weight of crude ash.	Per cent. of crude ash in dry leaf.
No. 1	65.7083	7.00	61.109	15.8213	25.89
2	57.0000	7.47	52.743	10.7160	20.32
3	75.0000	7.83	69.1275	19.1795	27.74
4	75.0000	9.25	68.0625	19.6310	28.84
5	75.0000	7.15	69.638	15.9275	22.88
6	75.0000	8.27	68.7975	16.2522	23.62
7	77.5175	7.13	71.991	15.5685	21.62
8	75.0020	7.80	69.152	18.4290	26.65

To prepare the crude ash the air-dry tobacco was burned at a heat scarcely rising to visible redness. The ash as thus obtained includes the sand and earth that adhered as dust to the leaf, and also small amounts of unburned carbon. A little moisture absorbed subsequently to the burning also figures in the analyses.

The potassium in the ash being partly combined with chlorine and partly with oxygen, it is necessary to deduct oxygen equivalent to chlorine when, as is most convenient for comparison, the potassium is all given as potash.

Composition of Crude Ash of Tobacco Leaf.—Table II.

	Burn well.						Burn badly.	
	Sweated.				Unsweated.			Sweated.
	1	2	3	4	5	6	7	8
Sand and soil insoluble in Acids and Silica	25.10	3.65	7.75	19.50	4.52	5.30	7.90	8.20
Oxide Iron & Alumina	1.63	.20	.35	1.25	.28	.22	.96	.81
Lime	21.80	23.92	24.30	19.61	23.57	22.25	25.23	19.32
Magnesia	5.08	6.84	5.44	12.10	8.71	8.57	6.48	7.27
Potash	15.13	28.18	25.72	18.22	26.02	26.50	23.20	28.29
Soda	.29	.30	.37	.59	.29	.15	.42	.11
Phosphoric Acid	1.92	3.65	3.46	2.05	2.14	2.18	2.24	1.79
Sulphuric Acid	3.05	3.93	4.53	4.08	5.99	6.62	3.98	4.31
Carbonic Acid	16.20	23.30	24.96	16.20	22.54	20.50	21.40	19.40
Chlorine	5.43	4.08	.89	4.72	4.12	5.58	6.30	7.62
Carbon	3.55	1.21	1.56	1.66	.98	2.05	1.94	2.35
Water	1.90	1.10	.80	1.14	.90	1.10	1.30	2.16
	101.08	100.36	100.13	101.12	100.06	101.02	101.35	101.63
Oxygen equivalent to Chlorine	1.22	.92	.20	1.06	.93	1.25	1.42	1.72
	99.86	99.44	99.93	100.06	99.03	99.77	99.93	99.91

The analyses of crude ash do not serve as a proper basis for comparison because of certain accidental or variable ingredients which they include. These analyses show to some extent the accuracy of the chemical work, and serve as the basis for calculating the composition of what is termed the pure ash.

Deducting from the crude ash in each case the accidental ingredients, viz: sand and soil, carbon and water, and also the carbonic acid which is likely to be retained to a variable degree, and reckoning the remaining ingredients to 100, we arrive at the following statement:

Composition of Pure Ash.—Table III.

	Burn well.						Burn badly.	
	Sweated.				Unsweated.			Sweated.
	1	2	3	4	5	6	7	8
Oxide Iron & Alumina	3.04	.28	.54	2.01	.39	.31	1.42	1.17
Lime	40.66	33.76	37.34	31.81	33.18	31.62	37.16	28.38
Magnesia	9.47	9.66	8.36	19.80	12.26	12.18	9.54	10.67
Potash	28.21	39.76	39.48	29.42	36.62	37.69	34.17	41.54
Soda	.54	.42	1.11	.94	.40	.21	.61	.17
Phosphoric Acid	3.58	5.15	5.31	3.31	3.01	3.10	3.30	2.62
Sulphuric Acid	5.69	5.55	6.95	6.60	8.43	9.41	5.86	6.31
Chlorine	10.13	5.76	1.36	7.65	5.80	7.93	9.28	11.19
	101.32	100.34	100.45	101.54	100.09	102.45	101.34	102.05
Oxygen equivalent to Chlorine	2.28	1.30	0.31	1.72	1.31	1.79	2.09	2.52
	99.04	99.04	100.14	99.82	98.78	100.66	99.25	99.53
Pure Ash, per cent.	13.80	14.38	17.99	17.74	16.25	16.80	14.58	18.08

The notion appears to have established itself that fertilizers containing chlorine, whether in the form of common salt, muriate of potash or kainite are highly detrimental to the quality, and especially to the burning quality of tobacco. It is also believed that lime and especially potash in the form of sulphates and carbonates, are favorable to the quality and particularly to the burning quality of tobacco.

It is likewise thought that slaughter-house offal and fish scrap are injurious, while Peruvian guano, castor pomace and cotton seed meal are beneficial to the quality of leaf tobacco, and this different effect is attributed to the supposed greater quantity of salt or other chlorine compounds contained in the offal and fish.

The chemical examination of tobacco-ash ought to make manifest whether there is a connection between burning quality and relative quantities of chlorine, potash or other ash-ingredient. As regards chlorine the above analyses show that while the pure ash of the well-burning leaf, in general, contains less than the ill-burning, and while the largest content of chlorine is found in the worst burner, No. 8, and the smallest in a good burner, No. 3, yet the bad burner, No. 7, contains less than the good burner, No. 1. Of the two samples 5 and 6 designated as "very good," one contains 5.8, the other, 7.9 per cent. of chlorine.

With respect to potash and lime, we find the most potash and least lime in the bad burner, No. 8, while the reverse is true of the good burner, No. 1. But the bad burner, No. 7, contains the next highest per cent. of lime with less potash than is present in the four good burners, Nos. 2, 3, 5, and 6.

The relative proportions of sulphuric acid and of the other ash-ingredients likewise stand in no obvious relation to the quality of the leaf.

The influence of the ash-ingredients on the burning quality of tobacco is however evidently not to be looked for merely in their mutual proportions, but also in their relations to the vegetable matter which burns in contact with them.

Tables I and III prove indeed that the proportion of total ash, whether "crude" or "pure," stands in no connection to quality.

To bring out the relations of individual ash-ingredients to quality, it is needful to reckon the quantities of them which exist in equal amounts of the dry leaf, as follows:—

PER CENT. OF ASH INGREDIENTS IN WATER-FREE TOBACCO LEAF.

TABLE IV.

	Burn well.						Burn badly.	
	Sweated.				Unsweated.			Sweated.
	Cuba.	Sumatra.	Wis.	Conn.	Conn.	Conn.	Conn.	Conn.
	1	2	3	4	5	6	7	8
Sand, Soil and Silica	6.49	.74	2.15	5.62	1.03	1.25	1.71	2.19
Oxide of Iron and Alumina	.42	.04	.10	.36	.06	.05	.21	.22
Lime (CaO)	5.65	4.86	6.76	5.65	5.39	5.25	5.45	5.15
Magnesia (MgO)	1.32	1.39	1.51	3.48	1.99	2.02	1.40	1.94
Potash (K_2O)	3.92	5.73	7.16	5.25	5.95	6.26	5.02	7.54
Soda (Na_2O)	.08	.06	.10	.17	.06	.04	.09	.03
Phosphoric Acid (P_2O_5)	.49	.74	0.95	.59	.49	.52	.48	.48
Sulphuric Acid (SO_3)	.79	.80	1.26	1.18	1.36	1.56	.86	1.15
Carbonic Acid (CO_2)	4.19	4.73	6.95	4.67	5.16	4.84	4.63	5.17
Chlorine	1.40	.83	.25	1.36	.94	1.32	1.36	2.03
Carbon	.92	.25	.43	.48	.23	.48	.42	.63
Water	.49	.22	.22	.33	.21	.25	.28	.58
	26.16	20.39	27.84	29.14	22.87	23.84	21.91	27.11
Oxygen equivalent to Chlorine	.31	.18	.05	.30	.21	.29	.30	.45
Summing of Analysis	25.85	20.20	27.79	28.84	22.66	23.55	21.61	26.66
Total Crude Ash, per cent.	25.89	20.32	27.74	28.84	22.88	23.62	21.62	26.65
Potash Carb. in Ash sol. in water	1.37	5.23	7.60	2.91	4.54	4.29	3.46	4.74

From Table IV we gather that there is in fact for the same amount of dry tobacco nearly one-third more chlorine in No. 8 than in No. 1, but we see likewise that badly burning No. 7 contains no higher proportion of chlorine than is contained in the well burning Nos. 6 and 4, and scarcely more than in No. 1.

Table IV reveals no connection between burning quality and abundance or deficiency of potash, lime or any other ash-ingredient since among the good burners may be found both higher and lower percentages of each ash-ingredient than exist in No. 7 and 8.

According to Schloesing* the ash of tobacco contains more potassium carbonate in proportion as it burns well while bad burning tobacco contains little or none. Nessler found this rule of Schloesing to have some exceptions. Dr. Moore in his valuable investigation of American tobaccos (report of 10th U. S. Census, Vol. III, p. 870) remarks that while with one exception out of 12 samples the seed-leaf varieties (wrappers) yielded more carbonate of potash than the others (plug, etc.,) the amount of carbonate in the seed-leaf stood in no simple relation to the combustibility.

This result is in accord with Table IV, in which the last item is potash carbonate of ash soluble in water. The smallest as well as the largest quantities are seen to be found in the good burners Nos. 1 and 3, while the medium quantities are found alike in good and bad burners.

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* The French Government has for many years maintained a Laboratory for the investigation of all questions connected with the culture and manufacture of tobacco. Schloesing, the able director of the laboratory, in an article contributed in 1877 to Wurtz's *Dictionaire de Chimie* writes in substance as follows: "Tobacco which, rolled into a cigar, holds fire for three minutes burns very well; if it holds fire for two minutes it burns well; for one minute it burns poorly; for half a minute it burns very poorly. The burning quality is absolutely independent of the variety of tobacco, of the thickness of the leaf, of the texture, of its strength, of its flavor, and of climate. It stands in relation only to the proportion of potash-salts of vegetable acids contained in the leaf and consequently to the richness in potash of the soil on which it grows."

"This theory of the combustibility of tobacco has been established by chemical analysis and by direct experiments in culture. The ashes of tobacco that burns well contain and yield to water, carbonate of potash, those of badly burning tobacco contain little or no carbonate but yield to water only sulphate or muriate of potash."

"The carbonate of potash is however a result of the burning of malate, citrate, tartrate and oxalate of potash and the burning quality is therefore related to the presence in the tobacco of these salts. If enough of the above named potash-salts

The very positive way in which Schloesing connects the burning qualities of tobacco with the amount of organic potash salts i the leaf or with the quantity of potash carbonate in the ash stand in sharp contrast with the foregoing results. The unequale facilities which Schloesing has enjoyed for investigation durin his long service to the French government, which monopolizes th sale of tobacco in all its forms in that country, and his recognize ability as an investigator may well make one hesitate to publis analyses which contradict his conclusions.

Nessler, Director of the Experiment Station at Carlsruhe, in hi valuable little book on "Tobacco, its Composition and its Treatment," and Dr. G. E. Moore of New York in his "10th Censu Report on the Chemistry of American Tobaccos," the only othe chemists, to my knowledge, who have studied the composition o tobacco with reference to its burning qualities, find Schloesing' views confirmed in a general way but have noted some exceptiona cases and conclude that burning quality is not so simply relate to presence of potash salts as Schloesing assumes.

It is quite certain that to pronounce upon the burning qualit of a sample of tobacco is not always an easy thing. Nessler ha made comparisons by cutting from 6 different leaves (from th plants of each experimental plot of 40 sq. ft.) a piece 1½ in. broa from the midrib to margin, kindling these pieces at a lamp-flam as uniformly as possible and noting for each piece the time durin which the combustion continued. The average of the 6 result was adopted. Nessler observes that the different leaves from th same stem burn unequally. The lowest leaves hold fire for th

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is incorporated with a badly burning tobacco to give an ash containing a certai amount of potash carbonate, the tobacco is thereby made to burn well."

"On the other hand a well-burning tobacco is caused to burn badly by impregnating it with a certain proportion of sulphate or muriate of lime or sulphate o muriate of magnesia. The effect of these salts is to convert the malate, citrate, tartrate and oxalate of potash into the corresponding lime or magnesia salts, so that, on burning, the ashes contain their potash as sulphate or muriate and contain no potash carbonate but carbonates of lime and magnesia."

"In a cigar the fire is held by the charred tobacco. If this char be compact the fire easily goes out but if it be light and porous it continues to burn just as a compact lump of wood charcoal soon ceases burning when taken from the fire while an equal mass of pulverized charcoal burns away to ashes."

"Now the oxalate, malate, citrate and tartrate of potash when heated melt before they burn and by further heating yield an inflated, highly porous coal, favorable for holding fire. But the corresponding salts of lime and magnesia give a compact coal which is easily extinguished."

least time, the upper leaves hold fire better, and the intermediate ones the best. The same leaf burns differently in its different parts. The tips and edges frequently hold fire longer than the inner portions. Nessler found that in some cases tobacco which at first burned badly improved by keeping, and after three years burned well. This happened where nitrate of soda and cow-manure were applied, and the improvement by age was probably a result of fermentation. Dr. Moore found considerable discrepancies in his comparisons, and the writer has had no better fortune.

Some trials were made upon single leaves taken in a state so dry that they required most careful handling, each leaf being folded lengthwise closely upon itself, forming a flattened irregular stick of tobacco some ½ to ¾ inch wide and ⅛ to ¼ inch thick. The leaves were supported horizontally, set on fire by a lamp flame, and the time of burning and distance in inches traversed by the fire were noted. The results are as follows, in four successive trials on different parts of the leaves:

	I.		II.		III.		IV.	
	Near Tips.		Near Middle.				Near Base.	
No.	Time.	Dist.	Time.	Dist.	Time.	Dist.	Time.	Dist.
8	2 min.	1¼ in.	2 min.	⅜ in.	1 min.	⅛ in.	½ min.	3/16 in.
6	2 min.	1¼ in.	2 min.	⅜ in.	2½ min.	¼ in.	1½ min.	⅛ in.
1	2 min.	¾ in.	4 min.	½ in.	2½ min.	3/16 in.	2½ min.	¼ in.
3	4 min.	2 in.	6 min.	1¼ in.	5½ min.	1⅛ in.	2½ min.	5/16 in.

In the above trials the conditions were indeed not favorable for strictly comparable results, since the different tobacco-leaves varied considerably as to extent and compactness of cross-section. They confirm, however, in a general way what Nessler asserts with regard to the unequal burning of different parts of the same leaf, and also agree with Mr. Austin's judgment in rating No. 8 as lowest in burning quality.

It is most probable that "burning quality" is the result of the coincidence of several conditions. The abundance of organic potash salts in the leaf, the abundance of cellulose (woody tissue), the abundance of sulphates are evidently favorable for easy burning. On the other hand, sugar, gum (pectic acid) and albuminous matters are difficult of combustion. Mineral salts which fuse at the burning temperature, such as chlorides of potassium and sodium and phosphates of potash and soda, hinder free burning. Fermentation, which reduces the quantity of sugar and albuminous matters, and perhaps also that of organic acids, and which may influence the distribution of the soluble salts, acts, on the whole, to improve the burning quality.

It therefore would seem evident that burning quality is good or bad according to the preponderance of favorable or unfavorable factors, and is not always related in a simple manner to the composition of the ash.

It would be going too far to assert that the use of chlorides (muriates) of fish or slaughter-house fertilizers *must invariably* produce tobacco of inferior quality. Nessler found in his field trials that application of salt generally gave badly-burning tobacco. In 1862, however, tobacco from the plot manured with salt, though containing little carbonate of potash in the ash, burned scarcely less well than the tobacco from adjoining plots to which carbonate of potash, sulphate of potash and stable manure had been applied.

The tobacco-grower will, however, do well to avoid the use of the above-named fertilizers, which experience in all countries agrees in indicating to be as a rule likely to injure the burning quality of the leaf.

TOBACCO STALKS.

The stalks* of tobacco after stripping off the leaves are recognized to have considerable fertilizing value, and are accordingly returned to the land.

Mr. Austin supplied a sample of stalks taken from the plants which gave the leaf-samples Nos. 5 and 6 already noticed. The average weight of the stalks was estimated by Mr. Austin at ½ lb. The number per acre was 8,000. The total produce per acre is therefore estimated at 4,000 lbs. As brought to the Station the stalks were thought to be in about the state of dryness usual at the time of stripping. They contained 45.7 per cent. of water. The dried tobacco gave, on burning, 11.04 per cent. of crude ash composed as follows:

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* These stalks are not to be confounded with the "Tobacco stems" of which an analysis is given in Station Report for 1878, p. 36. The "stems" are the midribs of the leaf rejected by the cigar manufacturers.

TOBACCO STALKS, COMPOSITION OF CRUDE ASH.

Sand, Silica and matters insoluble in acids	3 17
Oxide of Iron and Alumina	.30
Lime	8.53
Magnesia	5.15
Potash	43.93
Soda	.35
Phosphoric Acid (P_2O_5)	5.95
Sulphuric Acid (SO_3)	6.14
Chlorine	9.09
Carbonic Acid	14.80
Carbon	3.16
	100.57
Deduct Oxygen equivalent to Chlorine	1.04
	99.53

COMPOSITION OF TOBACCO STALKS.—TABLE V.

	Dry Stalks. Pounds per 100.		Moist Stalks. Pounds per 100.		Moist Stalks. Pounds per Acre.	
Water		....		45.70		1828 0
Vegetable Matter*		90.88		49.39		1975.6
Lime	.94		.51		20.4	
Magnesia	.57		.28		11.2	
Potash	4.85		2.63		105.2†	
Soda	.04		.02		.8	
Phosphoric Acid	.66		.36		14.4	
Sulphuric Acid	.68		.37		14.8	
Chlorine	1.00		.54		21.6	
Sand, Silica, Oxide Iron	.38		.20		8.0	
Ash-ingredients		9.12		4.91		196.4
		100.00		100.00		4000.0
* Containing total Nitrogen,		3.41		1.85		74.1

† 28.6 lbs. of potash exist as muriate, making 45.4 lbs. of the latter. The remaining 76.6 lbs. of potash exist mostly as carbonate and sulphate with a little nitrate. The dry stalks contained 0.2 per cent. of nitrogen in the form of nitrates, which corresponds to 30.4 lbs. nitrate of potash in 4000 of moist stalks.

The valuation of 4000 lbs. of stalks on the data above given is as follows:

Nitrogen of Nitrates,	4.34 lbs. at 18 cents,	=	$ .78
Nitrogen of Organic Matter,	69.76 lbs. at 20 cents,	=	13.95
Potash as Muriate,	28.60 lbs. at 4½ cents,	=	1.26
Potash in other forms,	76.60 lbs. at 7¼ cents,	=	5.55
			$21.54

The above valuation is correct for 4000 lbs., but is perhaps t high for the acre-yield of stalks, because of the uncertainty of t estimate as to the amount of dry matter per acre, viz: 2172 lb (=4000—1828) which is probably too high.

The average weight of four water-free stalks examined by t Director in 1872 was 3½ oz. (96 grams). On this reckoning 80 stalks would yield 1750 lbs. of dry substance instead of 2172 ll as above estimated. Dr. C. T. Jackson found in a crop raised Hatfield, Mass. (in 1857?), 1490 lbs. of water-free stalks to 17 of leaf. The valuation is very nearly one cent per lb. for the d (water-free) stalks or $21.54 for 2172 lbs., so that calling the ac yield of dry matter but 1500 lbs., the stalks would be worth $ per acre at current rates.

FEEDING STUFFS.

Twelve samples of feeding stuffs have been examined duri the year. Their analyses follow.

Maize Kernel.

CLXXXII, Canada Snub Corn, a variety long cultivated Northford. This sample was raised by T. F. Barnes, and se together with No. CLXXXIII by F. A. Hill. This corn is sa to give a larger yield than the following variety. The relati weights of kernel and cob were the same, 6 lbs. 2 oz. of kernel 1 lb. 6 oz. of cob, or 100 of the former to 22½ of the latter.

CLXXXIII, Canada Yellow Corn, raised by F. A. Hall, Nor ford. This variety has been grown in that place for only t years.

Analyses.

	CLXXXII.	CLXXXIII.
Water	16.66	16.50
Ash	1.03	1.32
Albuminoids	8.94	9.87
Fiber	.78	.91
Nitrogen-free extract (starch, sugar, etc.)	68.55	66.58
Fat	4.04	4.82
	100.00	100.00

Water Free.

Ash	1.23	1.58
Albuminoids	10.73	11.81
Fiber	.94	1.10
Nitrogen-free extract	82.26	79.75
Fat	4.84	5.76
	100.00	100.00

The above samples were sent for comparison as to their quality. The Canada Yellow contains one per cent. more of albuminoids and almost one per cent. more fat than the other variety, which however is claimed to be more prolific. So it may well be that the total crop of the Canada Snub Corn yielded more albuminoids and fat than the Canada Yellow. It would at any rate be unwise to generalize from a single analysis of each variety.

BEETS AND POTATOES.

CLXXX, White Star Potatoes from W. J. Jennings, Greens Farms.

CLXXXI, Sugar Beets, with regard to which Mr. Jennings says:—

"The beets are known as French Imperial Sugar Beets. Perhaps they do not yield quite equal to some of the mangel varieties, yet with strong ground 800 to 1,000 bushels per acre can be grown, equal to 20 to 25 tons. They appear to be equally hardy, and as easily cultivated as other beets.

They are better for feeding purposes than any other beets with which I am acquainted. Capital for sheep and cattle and good for swine."

The analyses are as follows:—

	CLXXX.	CLXXXI.
Water	78.01	84.42
Ash	1.00	1.13
Albuminoids	2.19	1.69
Fiber	.33	.93
Nitrogen-free extract *	18.39	11.75
Fat	.08	.08
	100.00	100.00

* Consisting in CLXXX chiefly of starch and in CLXXXI of cane sugar.

Water Free.

Ash	4.55	7.25
Albuminoids	9.96	10.85
Fiber	1.50	5.97
Nitrogen-free extract	83.63	75.41
Fat	.36	.52
	100.00	100.00

LINSEED MEAL.

A single sample of Linseed Meal, CLXXIV, has been analyz
Its analysis as a fertilizer has been given on page 67.

It was sent by H. H. Austin, of Suffield, who bought it
Wilder & Puffer, Springfield, Mass. Cost $28.00 per ton.

ANALYSIS.

		Water free.
Water	9 90	----
Ash	6.74	7.48
Albuminoids	35.81	39.74
Fiber	8.63	9.58
Nitrogen-free extract	36.65	40.68
Fat	2.27	2.52
	100.00	100.00

MIDDLINGS.

CLXXXIV is a sample of "Fancy Middlings" costing $1.30
one hundred pounds, sampled and sent by James W. Congd
Hampton.

ANALYSIS.

		Water free.
Water	10.93	----
Ash	2.41	2.71
Albuminoids	15.21	17.08
Fiber	2.00	2.25
Nitrogen-free extract	65.84	73.91
Fat	3.61	4.05
	100.00	100.00

It was stated that pigs refused to eat this bran. Nothi
abnormal could be discovered in the sample sent. The compo
tion is that of ordinary wheat middlings, except that there
much less fiber than usual, in this "fancy" middlings. It has
disagreeable or musty smell or taste. If there is disagreem
between the pigs and the middlings we apprehend that the fa
lies with the former.

WHEAT BRAN.

CLXXXV, a sample of wheat bran brought to the station by J. J. Webb, of Hamden, had the following composition:

		Water Free.
Water	11.90	----
Ash	6.33	7.18
Albuminoids	14.68	16.66
Fat	3.71	4.22
Nitrogen-free extract Fiber	63.88	71.92
	100.00	100.00

The sample was brought by Mr, Webb on account of its inferior appearance. It contained a good deal of black material, consisting of seeds and fragments of seeds that are foreign to bran.

The seeds were chiefly of two kinds, the corn cockle (*Lychnis Githago*, L.) and black bindweed (*Polygonum Convolvulus*, L.). The former is a pest in wheat fields because the seeds damage the color of the flour, and are said to impart a bitter taste to it, the latter is a common twining weed, not so troublesome as the cockle. The cockle seed we understand is separated from the wheat before milling. Its presence in wheat bran would therefore indicate that the refuse from this separation of cockle seed and light wheat, had been turned in with the bran, or that the bran had been prepared from an inferior quality of wheat. The chemical composition of the bran is however about the average.

HAY AND STRAW.

The following three samples are from A. S. Hubbard, Glastonbury.

CLXXV, Coarse meadow hay or bedding.
CLXXVI, Good meadow hay.
CLXXVII, Rye straw.

ANALYSES.

	CLXXV.	CLXXVI.	CLXXVII.
Water	11.04	10.48	9.73
Ash	6.58	6.00	2.75
Albuminoids	7.56	7.31	2.19
Fiber	28.69	26.93	43.29
Nitrogen-free extract	44.46	46.60	41.04
Fat	1.67	2.68	1.00
	100.00	100.00	100.00

With regard to the coarse hay and straw, Mr. Hubbard writ “ They are rather poorer fodders than we have been accustom to feed, but the early frost stopped the growth of the corn that we have been compelled to use them.” Analysis gives t same composition for the coarse hay and good hay, save respect to fiber and nitrogen-free extract.

MAIZE ENSILAGE.

CLXXVIII, Frost-affected Maize Ensilage.
CLXXIX, Drowth-affected Maize Ensilage.
Sampled and sent by A. S. Hubbard, Glastonbury.

ANALYSES.

	CLXXVIII. Frost-affected.	CLXXIX. Drouth-affected.
Water	85.42	83.04
Ash	2.94*	1.22
Albuminoids	1.75	.95
Fiber	4.17	6.09
Nitrogen-free extract	5.40	8.06
Fat	.32	.64
	100.00	100.00

* 2.00 per cent. consisted of sand and clay.

Water Free.

	CLXXVIII.	CLXXIX.
Ash	20.18†	7.19
Albuminoids	12.00	5.60
Fiber	28.60	35.92
Nitrogen-free extract	37.03	47.52
Fat	2.19	3.77
	100.00	100.00

† 13.73 per cent. consisted of sand and clay.

Mr. Hubbard writes : “ My stock eat the Ensilage much bett than I had expected, in fact the frost seems to have done no fu ther damage than to stop the growth of the corn before coming maturity.” The frosted ensilage has higher albuminoids (Protei than the average of our analyses (see Table, p. 114), but its nitr gen-free extract (carbhydrates) is lower than any yet put record. This is probably the result of freezing which ruptur the cell-tissue and makes their juices very accessible to ferme germs.

"The Concentrated Feed."

"The Concentrated Feed for horses, cattle, sheep, swine, poultry, etc., for sale by the Concentrated Feed Company, office No. 14 Pearl Place, Boston, Mass., U. S. A., O. P. Prall, Sup't."

A sample of "The Concentrated Feed" was sent to the Station in 1882, by Mr. Charles E. Lord, of Chester, with request to be informed of its value. To him was replied, "The station has a month's work to do before it can touch the Cattle Feed by way of making a regular analysis. Such an analysis is however hardly necessary.

The sample consists evidently of corn meal and perhaps fine bran or middlings, with some linseed cake, a good deal of salt and a little fenugreek to give it flavor. If you will refer to page 125 of the Station Report for 1878, you will find the analysis of a "Condimental Cattle Food," which is not unlike the sample you sent in composition and value. At $110 per ton it is a folly to buy it."

Subsequently Mr. Lord sent to the Station a copy of the analysis published by the Concentrated Feed Company, and stated "the manufacturer claims that it contains four to five times as much nutriment as corn, oats, etc." Thereupon was written, "The analysis of Concentrated Feed is received. Corn meal and linseed meal are now both quoted at $30 per ton or less. Bran or shorts at $25 per ton, and salt at $10 per ton. Accordingly the concentrated Food is worth for its raw materials, exclusive of fenugreek not more than $30 per ton. The cost of the latter and mixing certainly can't exceed $5 per ton. I should regard the stuff dear at $35 per ton. The claim that the mixture contains 4 or 5 times as much nutriment as corn, oats, etc., is false. A mixture of 40 lbs. corn meal, 40 lbs. bran, 16 lbs. linseed cake, and 4 lbs. salt would make 100 lbs. very nearly as good as The Concentrated Food." Another sample was recently sent to the Station by D. H. Van Hoosear, of Wilton, who stated that the Concentrated Food is offered for sale in bags of 50 lbs. each by Allen Betts & Co., of Norwalk, at 6 cents per pound.

The sample was analyzed and the station analysis is subjoined, together with the analysis (by B. F. Davenport, M.D., Mass. Coll. of Pharmacy), published in the Company's circulars, and also the average composition of Wheat Bran.

Analysis.

	by Dr. Davenport.	by Station.	of Bran
Water	13.12	13.51	11.76
Fat	6.66	1.79	3.90
Carbhydrates	48.89	51.57	55.07
Albuminoids	13.52	13.31	14.88
Fiber	8.57	3.30	8.70
Mineral Salts	9.24	16.52*	5.69
	100.00	100.00	100.00

* Contains 11.6 per cent. of common salt.

It is seen that the sample here analyzed differs somewhat fron that analyzed (March, 1881) by Dr. Davenport, containing less fa by 4.85 per cent. and more mineral salts by 7.28 per cent. Th sample here analyzed differs also from that sent in 1882, by Mr Lord, in having none of the aromatic odor of fenugreek. It ha in fact a musty smell and viewed under the magnifier containe numerous minute insect larvae. Therefore either the fenugreel has been left out of the sample from Norwalk, or by long keepin the flavor has passed from aromatic to musty.

The sample from Norwalk was found by microscopic examination, to consist largely of maize meal with some linseed meal The linseed meal was of the sort known as "new process," fron which the fat (oil) has been mostly extracted. It was no attempted to identify all the ingredients of the sample and othe varieties of feeding stuffs may have been present. It will b observed also, that so far as nutriment is concerned wheat brar at 1¼ cents per pound or less,† is not inferior to this "Concentrated Feed."

Notwithstanding the "satisfactory testimonials," as to the grea value of "The Concentrated Feed," there can be no doubt that i is worth as feed when new and fresh no more than good whea bran, because it is no more concentrated than bran. The difference between its cost and that of bran, viz: 4¾ cents per lb., i what the consumer must pay for the "manufacture." The claim that it has extraordinary nutritive and medicinal power are in al probability wholly fanciful and unfounded. As to the use of fenugreek and other aromatics, such as caraway, fennel, anise, ginger elecampane, etc., which have been employed in "Condimenta Foods," there can be no doubt that they are occasionally serviceable to sick animals, but their true place is that of medicine and not of food. Sir John Bennet Lawes, of Rothamstead, England, made, years ago, a most thorough practical trial on the use of condiments in feeding and demonstrated that there is no profit in it. One of his trials was made on twenty sheep (ten fed with plain food, ten with the same plus condiment), and continued twenty-eight weeks, when the animals were slaughtered and marketed. The *extra cost of feeding ten sheep with condiment* was £3 14s.; the result of the feeding being alike with condimented and with plain food.*

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† $1.25 per hundred or $23.50 per ton.

Sir John Lawes stated† that sheep ate no more food under the stimulus of condiments than without. Pigs, he found, indeed, to consume a larger quantity of food, but they assimilated no more and got no benefit from the increased consumption.

Abundant other testimony to the same effect may be found in the Agricultural Journals of Great Britain where Condimental foods were extensively tested twenty to twenty-five years ago.

TABLE OF THE COMPOSITION OF AMERICAN FEEDING STUFFS.

By Dr. E. H. JENKINS.

On the following pages is given the average composition of the fodders commonly used in this country, compiled exclusively from American analyses. The compiler has aimed to bring together all analyses which have been published and could be obtained up to September 1st, 1884. Probably a few have been overlooked.

In the first column of the tables is given the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

It is very desirable to know within what limits the composition of each fodder is likely to vary, and for that reason the maximum and minimum amounts of each ingredient have also been inserted in the table.

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* Experiments on the question whether the use of Condiments increases the Assimilation of Food by Fattening Animals, or adds to the Profits of the Feeder; by J. B. Lawes, F.R.S., Edinburgh Veterinary Review, 1862.

† Journal of the Royal Society of England, xxiii, p. 425.

Composition of Feeding Stuffs.

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
GREEN FODDER.																	
Maize fodder	22	7.10	30.89	*18.86*	.56	1.78	*1.30*	.14	.81	*0.32*	3.20	17.69	*10.65*	1.90	9.78	*5.37*	1.22
Maize fodder—ensilaged	31	12.32	27.82	*19.29*	.88	2.77	*1.47*	.27	1.80	*0.72*	5.62	13.47	*9.88*	4.04	10.02	*5.88*	1.34
Pea vine—ensilaged	1	----	----	*18.36*	----	----	*2.40*	----	----	*0.80*	----	----	*7.60*	----	----	*5.57*	1.99
Cow pea vines, green and succulent, with pods	2	13.97	17.90	*15.94*	3.00	3.25	*3.12*	0.58	0.62	*0.60*	5.34	8.46	*6.91*	2.87	4.09	*3.48*	1.83
Cow pea vines, probably after pods were removed	1	----	----	*27.19*	----	----	*1.85*	----	----	*0.21*	----	----	*7.86*	----	----	*15.27*	2.00
Soja bean, whole plants	2	30.15	30.65	*30.40*	3.88	3.94	*3.91*	1.05	1.55	*1.30*	14.24	14.39	*14.32*	8.26	8.91	*8.58*	2.29
Rye	5	----	----	*25.3*†	2.30	3.00	*2.60*	0.60	0.70	*0.65*	4.90	6.70	*5.90*	13.40	14.90	*14.30*	1.90
Beet leaves	1	----	---	*11.16*	----	----	*2.74*	----	----	*0.60*	----	----	*2.49*	----	----	*2.50*	2.83
Carrot leaves	1	----	----	*16.70*	----	----	*4.26*	----	----	*0.86*	----	----	*5.99*	----	----	*2.25*	3.34
Sorghum leaves	3	23.30	32.70	*27.00*	2.40	3.70	*3.10*	----	----	----	----	----	*15.1*‡	4.30	6.80	*5.20*	3.50
HAY AND DRY COARSE FODDER.																	
Clover hay	12	78.18	91.53	*84.98*	8.87	13.06	*11.38*	1.47	3.10	*1.98*	35.03	45.47	*40.11*	23.79	28.64	*26.35*	5.15
Hay containing much clover	6	85.70	88.63	*86.19*	6.38	14.42	*10.18*	1.50	3.09	*2.38*	42.07	45.19	*43.33*	19.66	29.53	*25.04*	5.26
Timothy hay	18	85.70	91.30	*87.42*	4.88	9.60	*6.36*	1.08	3.30	*2.03*	41.09	48.58	*44.89*	22.70	34.25	*29.93*	4.23
Timothy and Red Top	5	85.70	86.88	*85.94*	6.02	8.97	*7.45*	1.45	2.48	*1.97*	39.20	46.88	*44.45*	24.72	28.45	*26.82*	5.25
Low meadow hay	10	85.50	93.60	*89.50*	4.60	10.40	*7.70*	0.70	3.60	*2.20*	39.80	55.20	*43.60*	21.40	40.00	*30.20*	5.80
Salt marsh hay	11	81.40	92.80	*89.53*	4.30	7.80	*5.90*	1.63	3.10	*2.32*	34.10	53.67	*42.42*	27.00	37.90	*31.47*	7.42
Black grass hay	2	88.98	91.06	*90.02*	6.56	7.06	*6.81*	2.28	2.38	*2.33*	43.14	49.31	*46.26*	24.63	29.42	*27.01*	7.60
Black grass hay (with seed)	1	----	----	*90.84*	----	----	*7.50*	----	----	*2.96*	----	----	*51.44*	----	----	*22.10*	6.84
Hungarian grass hay	8	----	----	*83.30*	5.56	10.67	*6.59*	1.30	2.14	*1.81*	34.85	44.71	*42.49*	26.18	28.94	*27.16*	5.24
Maize fodder—field-cured	6	60.63	77.07	*67.95*	3.39	4.97	*4.29*	0.66	1.56	*1.24*	30.52	40.82	*35.96*	18.65	25.18	*22.14*	4.32

† Calculated to average water content.

‡ Includes fat.

Composition of Feeding Stuffs.—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
HAY AND DRY COARSE FODDER—*cont.*																	
Buckwheat straw	2	89.50	89.60	*89.55*	3.33	4.38	*3.85*	1 42	1.70	*1.56*	32.08	34.49	*33.28*	44 93	46.83	*45.88*	5.05
Oat straw	3	87.50	93.47	*89.89*	2.30	5.08	*3.35*	1.00	3 15	*2.07*	26.42	44.26	*36.97*	35 21	55.96	*42.78*	4.72
Rye straw	1	----	----	*87.5†*	----	----	*6.89*	----	----	*2 68*	----	----	*35.70*	----	----	*34.20*	8.03
Wheat straw	2	88.63	92.22	*90.43*	2.19	2.56	*2.37*	1.24	2.53	*1.89*	41.51	47.01	*44.27*	37.32	40.05	*38.68*	3.22
Cow pea vines	6	86.01	90.70	*88.95*	13.56	19.81	*15.68*	1.13	4.05	*2.87*	34.98	46.40	*42.17*	17.20	23.66	*1 .82*	8.41
ROOTS, BULBS AND TUBERS.																	
Beets (red)	2	10.54	12.32	*11.43*	1.48	1.73	*1.60*	.14	.21	*.18*	7.16	7.64	*7.40*	.64	1.69	*1.16*	1.08
Carrots	2	12.15	13.20	*12 68*	.97	1.99	*1.38*	.62	.71	*.67*	6.86	7.70	*7.28*	1.55	2.32	*1.93*	1.34
Mangolds	3	7.18	8.56	*7.96*	1.57	1.89	*1 70*	.03	.51	*.20*	3.56	4.91	*4.19*	.76	.91	*.82*	1.05
Onions	3	6.48	14.74	*11.56*	.77	2.28	*1.38*	.22	.36	*.27*	3.77	11.28	*8.61*	.63	.76	*.70*	0.59
Potatoes	2	20.31	22.39	*21.35*	1.14	1.32	*1.23*	.12	.14	*.13*	17.75	19.69	*18.72*	.28	.48	*.38*	0.89
Sweet potatoes	3	26.61	34.04	*29.72*	.45	1.28	*0.97*	.28	.36	*.31*	23.00	29.72	*26.13*	.60	2.50	*1.36*	0.93
Ruta bagas	1	----	---	*12.92*	----	----	*1.15*	----	----	*.09*	----	----	*9.11*	----	----	*1.16*	1.41
Turnips	1	----	----	*11.11*	---	----	*1.34*	----	----	*.09*	----	----	*8.11*	----	----	*.86*	0.71
Yam	1	----	----	*28.77*	----	----	*2.06*	----	----	*.25*	----	----	*25.24*	----	----	*.70*	.67
FRUITS, GRAIN AND OTHER SEEDS.																	
Apples	1	----	----	*15.89*	----	----	*.21*	----	----	*.28*	----	----	*14.26*	----	----	*.91*	0.23
Cucumbers	1	----	---	*4.30*	----	---	*.83*	----	----	*.21*	----	----	*1.95*	----	----	*.85*	.46
Peas	1	----	----	*21.94*	----	----	*4.37*	----	----	*.55*	----	----	*14.48*	----	----	*1.66*	.88
Squash	2	4.82	5.42	*5.12*	.64	.68	*.66*	.24	.32	*.28*	2.95	3.54	*3.24*	.53	.54	*54*	.40
Tomato	1	----	--	*8.74*	----	----	*1.00*	----	----	*.47*	----	----	*5.84*	----	----	*.70*	.73
Barley	9	87.40	92.80	*88.90*	8.60	15.70	*12.40*	1.50	3.20	*1.80*	66.70	73.00	*69.30*	1.30	4.20	*2 90*	2.50
Buckwheat	8	85.10	89.10	*87.40*	8.60	11.00	*10.00*	2.20	2.40	*2.25*	62.60	65.40	*64.50*	7.80	9.40	*8.70*	2.00

† Calculated to average water content.

COMPOSITION OF FEEDING STUFFS.—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FRUITS, GRAIN AND OTHER SEEDS—*cont.*																	
Cotton seed, hulls and kernel	1	----	----	*92.28*	---	----	*15.72*	----	----	*18.56*	----	----	*29.09*	----	----	*25.75*	3.16
Cow pea	5	79.20	89.99	*85.21*	19.30	23.00	*20.77*	1.30	1.60	*1.43*	48.10	61.99	*55.75*	3.37	5.00	*4.06*	3.20
Doura (brown)	3	87.30	92.40	*89.00*	9.00	11.50	*10.30*	----	----	*4.20*	----	----	*69.90*	----	----	*1.50*	1.60
Soja bean	3	89.87	93.95	*91.41*	34.63	38.62	*36.22*	16.80	19.00	*17.92*	26.20	30.50	*28.66*	3.69	5.00	*4.24*	4.37
Maize kernel (dent)	77	85.95	93.78	*89.93*	7.53	12.07	*10.36*	3.80	6.93	*5.15*	66.26	75.73	*70.60*	1.25	4.81	*2.29*	1.53
Maize kernel (flint)	63	81.84	93.41	*88.93*	7.00	13.65	*10.67*	3.40	7.13	*5.00*	64.95	74.62	*70.08*	.78	2.88	*1.71*	1.47
Maize kernel (sweet)	24	89.14	94.02	*91.42*	9.45	15.31	*11.71*	5.25	11.89	*8.31*	61.78	72.35	*66.54*	1.46	5.24	*2.82*	1.93
Maize kernel ("Western corn")	3	79.30	83.60	*80.90*	7.80	8.60	*8.30*	3.60	3.90	*3.70*	64.90	68.20	*66.00*	1.70	1.80	*1.75*	1.20
Maize kernel (average of all varieties)	176	79.30	94.02	*89.51*	7.00	15.31	*10.62*	3.40	7.13	*5.49*	61.78	75.73	*69.72*	.78	5.24	*2.13*	1.55
Oats	21	86.50	91.10	*89.30*	8.00	14.40	*11.30*	4.10	5.80	*5.00*	57.10	66.90	*61.00*	1.50	12.90	*9.00*	3.00
Rice	10	86.00	88.60	*87.60*	5.90	8.60	*7.40*	0.30	0.60	*.40*	77.50	80.60	*79.20*	.10	.40	*.20*	.40
Rye	6	86.80	91.30	*88.40*	9.50	12.10	*10.60*	1.40	2.10	*1.70*	70.70	73.90	*72.60*	1.40	2.10	*1.60*	1.90
Sorghum seed	9	83.24	90.72	*87.48*	7.67	11.25	*8.88*	2.12	4.60	*3.65*	66.81	73.59	*71.27*	1.48	3.21	*1.88*	1.80
Wheat (winter)	229	83.77	92.90	*89.63*	8.25	16.63	*11.82*	1.26	3.93	*2.14*	68.08	76.64	*72.04*	.44	2.87	*1.77*	1.86
Wheat (spring)	13	86.65	91.88	*89.63*	8.14	15.40	*12.51*	1.82	2.56	*2.20*	66.07	78.66	*71.19*	1.33	2.30	*1.82*	1.91
Wheat (unclassified)	54	87.62	90.64	*89.28*	9.80	14.70	*11.97*	1.64	2.83	*2.09*	68.52	74.65	*71.49*	1.21	3.05	*1.91*	1.82
Wheat (average of all analyses)	296	83.77	92.90	*89.56*	8.14	16.63	*11.87*	1.26	3.93	*2.13*	66.07	78.66	*71.90*	.44	3.05	*1.79*	1.85
FLOUR AND MEAL.																	
Barley meal	3	83.80	86.00	*84.90*	8.80	13.90	*11.80*	0.70	2.20	*1.70*	----	----	*70.90*	----	--	*.10*	0.50
Buckwheat flour	3	85.06	87.22	*86.48*	4.18	8.00	*6.48*	0.65	1.74	*1.33*	75.81	79.37	*77.34*	.21	.35	*.28*	1.05
Graham flour	3	86.30	87.90	*86.90*	11.30	12.40	*11.70*	1.50	1.90	*1.70*	69.80	70.00	*69.80*	1.80	2.00	*1.90*	1.80
Hominy	2	86.38	86.64	*86.51*	8.08	8.41	*8.25*	.42	.46	*.44*	77.07	77.18	*77.12*	.31	.33	*.32*	.38

Composition of Feeding Stuffs.—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FLOUR AND MEAL—*continued.*																	
Maize meal	20	75.46	90.14	*85.14*	7.38	13.94	*9.26*	2.36	4.63	*3.82*	60.72	72.70	*68.58*	.93	2.99	*2.29*	1.54
Oat meal	6	91.16	93.77	*92.15*	12.87	16.25	*14.66*	6.05	8.77	*7.06*	66.62	68.99	*67.57*	.64	1.15	*.86*	2.00
Rye flour	4	86.42	87.65	*86.90*	6.00	7.05	*6.65*	.78	.89	*84*	77.56	79.09	*78.28*	.35	.45	*.41*	.72
Wheat flour,* from winter wheat	1	----	----	*87.04*	----	----	*8.56*	----	----	*1.19*	----	----	*76.59*	----	----	*.17*	.53
Wheat flour, from spring wheat†	6	86.50	89.70	*87.68*	8.56	14.12	*10,68*	.56	2.01	*1.11*	68.32	78.11	*75.00*	.00	1.22	*.22*	.64
Wheat flour (unclassified)	17	86.83	88.81	*87.54*	9.69	13.31	*11.28*	.81	1.88	*1.15*	69.52	76.93	*74.43*	.06	.99	*.16*	.52
Wheat flour (average of all varieties)	24	86.50	89.70	*87.56*	8.56	14.12	*11.01*	.56	2.01	*1.14*	68.32	78.11	*74.67*	.00	1.22	*.18*	.56
BY PRODUCTS AND REFUSE.																	
Apple pomace	3	22.80	27.40	*25.90*	1.00	1.70	*1.40*	1.70	2.00	*1.90*	15.70	17.00	*16.70*	3.90	5.90	*5.20*	.70
Brewers' grains, from brewery	7	21.71	31.36	*25.46*	4.69	7.75	*6.01*	1.47	2.94	*1.85*	10.11	15.73	*12.63*	3.10	5.58	*3.96*	1 01
Brewers' grains, kiln dried	1	----	----	*97.40*	----	---	*20.40*	----	----	*6.40*	----	----	*54.90*	----	----	*11.80*	4.00
Brewers' swill	1	----	----	*5.70*	----	----	*1.90*	----	----	*.80*	----	----	*2.00*	----	----	*.70*	.30
Cotton seed meal	22	90.87	94.32	*92.17*	22.27	50.81	*42.45*	10.24	18.01	*13.36*	12.74	38.68	*23.49*	2.77	11.76	*5.67*	7.20
Linseed cake	2	89.66	91.65	*90.62*	34.14	34.93	*34.53*	5.22	6.06	*5.64*	33.44	37.43	*35.42*	7.97	9.36	*8.66*	6.37
Linseed meal	4	87.53	93.83	*91.28*	27.68	33.95	*31.23*	5.16	11.57	*8.72*	31.45	44.89	*37.75*	7.12	7.57	*7.34*	6.24
Linseed meal (new process)	6	86.65	93.21	*89.49*	27.10	37.10	*33.45*	1.30	4.01	*2.83*	35.22	48.03	*38.78*	7.58	9.00	*8.37*	6.06
Palm nut meal	3	89.16	93.86	*91.71*	13.53	16.01	*14.39*	6.41	18.73	*13.30*	33.85	41.66	*38.88*	18.75	23.98	*21.40*	3.74
Sorghum meal, from seed mostly decorticated	1	----	----	*86.84*	----	----	*8.25*	----	----	*3.85*	----	----	*71.27*	----	----	*1.88*	1.59
Sorghum bagasse	3	11.30	16.60	*14.50*	0.62	0.68	*0.65*	----	----	----	----	----	*10.20*	2.80	3.30	*3.10*	0.60
"Hominy chops," "hominy feed," "Baltimore meal," "white meal"	8	86.47	91 07	*88.18*	7.88	10.20	*9.45*	4 45	10.20	*7.78*	60.95	71.10	*65.12*	2.54	4.79	*3.47*	2.36

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* The average of 18 analyses, most of them incomplete, is: Total dry matter, 89.63; Ash, .64; Protein, 10.92.

† The average of 16 analyses, some of them incomplete, is: Total dry matter, 88.55; Ash, .60; Protein, 11.63.

Composition of Feeding Stuffs.—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
By Products and Refuse—*continued.*																	
Gluten meal	2	91.57	92.60	*92.13*	28.03	35.00	*31.51*	8.01	8.73	*8.37*	44.72	54.46	*49.60*	.73	3.25	*1.99*	.66
Maize cob	13	85.58	92.82	*90.67*	1.23	3.73	*2.50*	.08	.92	*.47*	45.31	66.38	*55.99*	28.23	38.26	*30.36*	1.33
"Starch feed," refuse from starch manufacture	2	27.80	37.70	*32.90*	3.60	5.70	*4.60*	1.30	2.00	*1.60*	18.80	28.90	*23.80*	1.60	3.40	*2.50*	0.20
"Sugar feed," refuse from glucose manufacture (dry)	2	89.60	93.40	*91.50*	13.10	13.50	*13.30*	5.90	11.20	*8.60*	54.90	61.40	*58.10*	8.40	10.70	*9.50*	2.00
"Glucose waste," (wet)	1	....	....	*24.00*	....	....	*3.72*	....	....	*1.63*	....	....	*17.39*	....	....	*.75*	0.51
Malt sprouts	3	88.03	92.69	*89.73*	21.00	25.91	*22.95*	1.09	2.98	*1.79*	45.47	50.30	*48.60*	9.30	11.99	*10.72*	5.67
Rye bran	3	86.30	89.70	*87.70*	12.60	16.80	*15.26*	1.79	2.60	*2.19*	59.75	67.00	*63.12*	2.50	4.10	*3.51*	3.62
Wheat middlings	9	86.15	89.44	*88.03*	10.13	15.00	*12.27*	2.07	4.35	*3.23*	60.21	70.86	*65.48*	3.47	7.45	*4.58*	2.47
Wheat bran	2	85.82	91.35	*87.98*	7.81	16.89	*14.54*	2.39	5.84	*3.66*	50.41	58.93	*55.16*	7.24	16.64	*8.79*	5.83
Wheat shorts	6	86.41	89.04	*88.15*	11.13	15.13	*13.14*	2.50	4.85	*3.79*	55.62	62.32	*58.96*	6.34	10.47	*7.94*	4.32
Rice flour	1	....	....	*89.68*	....	....	*14.00*	....	....	*13.49*	....	....	*51.22*	....	....	*6.12*	4.85
Rice meal	1	....	....	*84.90*	....	....	*9.30*	....	....	*1.60*	....	....	*59.90*	....	....	*8.10*	6.00
"Rice polish"	1	....	....	*88.79*	....	....	*12.93*	....	....	*7.69*	....	....	*62.96*	....	....	*2.41*	2.80
Rice feed	1	....	....	*89.67*	....	....	*11.43*	....	....	*11.49*	....	....	*47.20*	....	....	*9.93*	9.62
Rice bran	1	....	....	*90.70*	....	....	*12.78*	....	....	*5.23*	....	....	*62.34*	....	....	*2.00*	8.35
Rice bran, "douse"	1	....	....	*91.22*	....	....	*10.93*	....	....	*8.20*	....	....	*41.93*	....	....	*17.76*	12.40
Rice hulls	2	91.50	92.30	*91.90*	3.12	4.68	*3.90*	0.55	0.65	*.60*	38.74	41.60	*40.17*	30.27	38.57	*34.42*	12.81
Rice straw	1	....	....	*96.34*	....	....	*4.68*	....	....	*1.74*	....	....	*50.90*	....	....	*28.31*	10.71

SEEDS.

During the year a considerable number of seeds have been tested both for seedsmen and for those who have bought of them.

The samples whose examinations are reported (see next page), were bought by an agent of the station, and in most cases from the contents of boxes of garden seeds which bore the names of the firms mentioned. The purchases were made in Bridgeport, Hartford and Middletown rather than in smaller and more remote places where there is more suspicion that the seed may not be in all cases fresh.

Fifteen out of the forty-eight samples examined, or about 31 per cent., are of quite inferior quality, and three of them were absolutely worthless.

Variety.	Put up by	Station No.	Seed sprouted, per cent.	½ the sprouted seed germina-
ONION—				
White Portugal.	John Reck, Bridgeport.	283	.3	--
Large Wethersfield.	" "	285	1.0	--
Southport White Globe.	Hegemann & Sturgis, Bridgeport.	294	79.0	4
Yellow Danvers.	Comstock, Ferre & Co.	297	86.3	5
Wethersfield Large Red.	" "	298	57.0	5
Early Red Globe.	" "	299	61.1	5
Danvers Yellow.	A. H. Dunlap & Sons.	300	48.0	5
True Danvers Yellow.	D. M. Ferry & Co.	301	73.3	5
Early Red.	" "	302	81.8	6
Large Red.	" "	303	26.8	6
Early Danvers Round Yellow.	Rice, Cambridge, N. Y.	304	71.0	6
White Portugal or Silver Skin.	" " "	305	70.0	6
RADISH—				
Early Red Turnip.	John Reck, Bridgeport.	284	86.8	3
French.	Hegemann & Sturgis, Bridgeport.	295	79.5	4
Early Scarlet Turnip.	Comstock, Ferre & Co.	317	77.0	3
Early Long Scarlet.	A. H. Dunlap & Sons.	318	36.8	10
Scarlet Turnip.	" "	319	47.8	5
Early Scarlet Turnip.	D. M. Ferry & Co.	320	54 6	5
New Breakfast French.	" "	321	68.5	5
Early Scarlet Turnip.	Hiram Sibley.	322	37.3	5
TOMATO—				
Livingston's Perfection.	John Reck, Bridgeport.	288	78.0	7
Trophy.	Comstock, Ferre & Co.	312	57.3	7
New Early Perfection.	A. H. Dunlap & Sons.	313	96.0	7
Early Acme.	" "	314	77.0	7
Early Round Smooth Red.	Johnson & Robbins.	315	66.8	7
Trophy.	Ferry & Co.	316	87.3	5
LETTUCE—				
Early Curled Simpson.	Hegemann & Sturgis, Bridgeport.	289	88.0	3
Hanson.	A. H. Dunlap & Co.	306	97.0	4
Early Curled Silesia.	" "	307	82.5	4
Ferry's Early Prize Head.	D. M. Ferry & Co.	308	86.8	4
Early Curled Silesia.	Hiram Sibley.	309	27.1	4
Early Curled Silesia.	Rice, Cambridge, N. Y.	310	93.0	4
Hanson.	" " "	311	87.8	4
CABBAGE—				
Flat Dutch.	Hegemann & Sturgis, Bridgeport.	290	92.8	3
Early Jersey Wakefield.	A. H. Dunlap & Sons.	330	33.2	4
Mammoth Late Flat Dutch.	" "	331	8.0	--
Premium Flat Dutch.	Rice, Cambridge, N. Y.	332	32.0	4
True Early Winningstedt.	" " "	333	65.8	4
True Early Winningstedt.	D. M. Ferry & Co.	334	89.3	3
Early Drumhead.	" "		94.5	3
TURNIP—				
Early White Egg.	A. H. Dunlap & Sons.	325	90.0	3
Early White Flat Dutch.	Rice, Cambridge, N. Y.	326	96.5	3
Ruta Baga.	" " "	327	84.8	5
New White Egg.	" " "	328	95.0	3
Golden Ball.	Johnson, Robbins & Co.	329	90.0	3
PEA—				
Henderson's First of All.	Hegemann & Sturgis, Bridgeport.	291	99.0	3
CARROT—				
Square Orange.	Hegemann & Sturgis, Bridgeport.	292	51.8	4
CUCUMBER—				
Early White.	Hegemann & Sturgis, Bridgeport.	296	95.8	2

REPORT OF THE BUILDING COMMITTEE.

The Act entitled "*An Act concerning The Connecticut Agricultural Experiment Station*" (Public Acts of 1882, p. 213, Chapter CXXXIII), was approved April 26, 1882, and appropriated twenty-five thousand dollars to the Station "for the purpose of buying a suitable lot and erecting thereon buildings, and equipping the same for the permanent use of said Station."

A special meeting of the Board of Control was held May 9th, 1882, at which the Executive Committee described the several parcels of land they had examined, and laid before the Board correspondence relative to property brought to their notice in other parts of the State, with such other information as they had pertaining to the matter.

The Board, after visiting several lots and parcels of land in and about New Haven, and after discussing the merits and prices of each, directed the Treasurer to purchase the lot on Suburban street, if it could be done on certain terms. A building committee was chosen, consisting of the Hon. H. B. Bigelow, Messrs. T. S. Gold, J. J. Webb, S. W. Johnson and Wm. H. Brewer to carry out the intentions of the Act.

This Committee organized the same day, choosing Governor Bigelow, Chairman, Mr. Webb, Vice-Chairman, and Mr. Brewer, Secretary. A second meeting was held May 12th at which certain preliminaries were transacted, and May 13th the property was bought for twelve thousand (12,000) dollars, and immediate possession given.

The property consists of about five acres of land on Suburba street, in the immediate suburbs of New Haven and just withi the city limits, about one and five-eighths miles from the Cit Hall and near the Whitneyville Horse Railroad. There was large dwelling house, a barn, and a well on the property.

A new laboratory was planned and a substantial brick buildin built for this use during the same year. The station office wa opened in its new quarters in September of that year, but th laboratory was not in condition for much chemical work until th next February. This building was formally accepted from th builders Jan. 13th, 1883, and up to the date of the annual mee ing of the Board of Control, three days later, the amount e pended was $20,809.04.

During the next fiscal year, the fitting up of this laborator was finished, sundry repairs made, and $3,029.96 was expended.

While this work had been going on, a new law concerning com mercial fertilizers had been passed which modified the work re quired of the Station, so the Committee after consultation wit the Board of Control decided to defer using the remainder of th special appropriation until the next year, by which time exper ence with the working of the new law and the running of th Station in its new quarters would indicate how the small balanc could be used to the best advantage to the State. The balanc was put into the savings bank for the winter.

Early in 1884 various plans were considered, and after sever meetings and careful consideration of the matter by the Com mittee and the full Board, the Committee decided to erect wooden addition to the north end of the house. The contra was made May 12th, 1884, and the addition handed over by th contractor and occupied by the Station in July. On this th balance of $1,207.46 was used.

With the expiration of Governor Bigelow's term of office a Governor, Mr. Webb became Chairman until July 1st, 1884, whe his term of office as member of the Board of Control expire Mr. Gold was then chosen Chairman. No new members wer added as these dropped out by limitations of office.

The total receipts and expenditures by this Committee are as follows:

Special appropriation	$25,000.00	
Savings bank interest on deposit	46.46	
		$25,046.46
The property as bought	12,000.00	
Unexpired insurance	26.99	
Lumber on place	11.06	
Water connection	500.00	
Gas connection	155.75	
Builder's contracts,	6,662.46	
Architect	277.75	
Steam heating apparatus	800.64	
Sundry carpenter's bills	2,288.35	
Masons' bills for repairs	545.21	
Plumbing, gas fitting and drainage	1,530.02	
Painting and glazing	248.23	
		$25,046.46

All the accounts pertaining to this special appropriation have been examined, audited and balanced by the State Auditors, and closed.

The buildings are now in good repair and condition.

Signed, T. S. GOLD,
S. W. JOHNSON,
WM. H. BREWER.

ERRATA.

Page 41, Station No. **1235**, under Phosphoric Acid Available, for 9.82 read 10
" 42, " **1216**, " " " " 8.24 " 7
" 44, " **1313**, " " " " 9.00 " 10
" 56, " **1318**, " " " " 6.66 " 6
" 42, " **1186**, " Phosphoric Acid total, for 13.66 " 13
" 55, " **1160**, for Bowker's read Stockbridge's.
" 55. " **1155**, " " " "

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STATE OF CONNECTICUT.

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The Station

The Connecticut Agricultural Experiment Statio

OFFICERS FOR 1885.

STATE BOARD OF CONTROL

Ex-officio.
HIS EXC. HENRY B. HARRISON, *President.*

Appointed by Connecticut State Agricultural Society: Term expi
HON. E. H. HYDE, Stafford, *Vice-President.* July 1, 188

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PROF. W. O. ATWATER, Middletown. 188

Appointed by Governor and Senate:
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H. L. DUDLEY, New London. 188

Appointed by Board of Agriculture:
T. S. GOLD, West Cornwall. 188

Executive Committee.

Appointed by Governing Board of Sheffield Scientific School:
W. H. BREWER, New Haven, *Secretary and Treasurer.* 188

Ex-officio.
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Chemists.
E. H. JENKINS, PH.D., *Vice-Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, JR., PH.B.

In charge of Buildings and Grounds.
CHARLES J. RICE.

ANNOUNCEMENT.

The Connecticut Agricultural Experiment Station was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, waters, milks, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on the various subjects of Agricultural Science, for the use and advantage of the Citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, &c., &c., for the Citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 52.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be prepaid, and all communications should be directed, not to individual officers, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban St., between Whitney Avenue and Prospect St., 1¼ miles North of City Hall. Suburban St. may be reached by Whitney Lake Horse Cars, which leave corner of Chapel and Church Sts. each hour and half hour.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State St., or from Peck & Bishop's Office in Union R. R. Depot.

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REPORT OF THE BOARD OF CONTROL.

To the General Assembly:

The Board of Control of The Connecticut Agricultural Experiment Station begs leave to present the following Report.

The Experiment Station has been occupied during 1885 as in former years, mostly with the analysis of Commercial Fertilizers and Feeding Stuffs. The State "Law Concerning Fertilizers" in its 9th Section requires the Director of the Station to make and publish annually at least one analysis of each Commercial Fertilizer sold in Connecticut. This work has been going on throughout the entire year, and during the period from April to November has very fully employed the Station chemists. Its records show that the Station has tested 16 samples of seeds and made analyses of 256 fertilizers, 21 feeding stuffs, 14 soils, 2 samples of milk and several drinking waters. It has investigated two cases of suspected cattle poisoning, in one of which arsenic was found, and has published and distributed 4 printed Bulletins, each averaging 10 pages, in editions of 5,000 copies, and has issued 14 "weekly statements" printed by the hektograph process, and supplied to the Agricultural Press and to the Secretaries of Farmers' Club and Agricultural Societies. Much labor has been bestowed on "vegetation experiments" and on the solubility of the nitrogen of fertilizers. The new requirement that Reports to the General Assembly are to be prepared and printed by the first of November cannot for various reasons be carried out in respect to the details of this work, which properly constitute the Report of the Director of this Station. That Report in past years has been especially valuable to Farmers and Gardeners, because it has put in their possession a very accurate and complete account of the composition and relative values of all the commercial fertilizers and of most of the concentrated cattle foods found in our markets, so explained and tabulated as to make reference to them and their comparison instructive and easy. These analyses furnish a mass of data which, published in winter, has become indispensable to practical agriculturists in planning their operations for the coming summer, and it is of the highest importance to them that the information be as complete as possible and be brought down to the latest date. The Director cannot finish his Annual Report in a satisfactory manner until the work of nearly the entire calendar year is completed. To close the Station work early in October as would be necessary in order to make and print a Report by the first of November, would in our opinion seriously impair the practical usefulness of the Station. Futhermore the printing of the Director's Report is necessarily slow, great care and repeated proof-reading being required to insure correctness of the numerous tables of analyses which it contains.

The Director's Report for 1885 is in preparation, but it cannot be ready for the printer until well into December, and the printing and proof-reading will require several weeks in addition.

We therefore request that the printing of the Director's Report be authorized to proceed as in former years and that provision be made for the future to except it from the operation of the law requiring all Reports to be made and printed the first of November. The Director's Report hitherto has been mostly or entirely in type at the time designated in the Act establishing the Station for the regular Annual Meeting of this Board, viz: "on the third Tuesday in January of each year." We request that as long a time for presenting the Director's printed Report be permitted in future years.

November, 1885.

HENRY B. HARRISON,
President.

W. H. BREWER,
Secretary.

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with the Connecticut Agricultural Experiment Station.*

December 1, 1884, to June 30, 1885.

Receipts.

Balance from account of 1884	$833.78	
Annual Appropriation (6 months)	4,000.00	
Analysis Fees	3,635.40	
Sale of Bulletins and Reports	16.25	
		$8,485.43

Payments.

Salaries	$4,602.69	
Laboratory expenses	1,258.21	
Grounds and Establishment, repairs and improvements	1,343.86	
Printing	205.95	
Stationery	99.71	
Postage	173.90	
Library	212.70	
Collecting Fertilizers	113.91	
Traveling expenses of the Board of Control	48.14	
Telephone	50.00	
Water	66.00	
Gas	218.40	
Insurance	58.15	
Miscellaneous sundries	20.48	
Balance on hand	13.33	
		$8,485.43

WM. H. BREWER, *Treasurer.*

Memorandum.

This report covers the seven months between the old and new fiscal years of the State. The receipts represent half of a year's annual appropriation and practically the analysis fees established by law for a whole year, nearly all falling due in the second quarter of the calendar year.

WM. H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

During the past year the work of this Station has gone on without interruption.

As in former years the analysis of commercial fertilizers, and work connected with the collection, examination and valuation of samples has occupied the larger part of the time of the Station's working force.

The present Fertilizer Law makes this necessary by prescribing that the Station shall analyze each year at least one sample of every brand of fertilizer offered for sale in the State. As the goods of different manufacturers are compared and judged of largely by these analyses it is necessary both for the credit of the Station and the protection of manufacturers and consumers alike that the utmost care should be used in drawing the samples, making the analyses and interpreting the results. These operations require a large outlay of time and work, which does not appear in the brief statement of results that is given in the Report.

The number of brands of fertilizers legally sold in Connecticut the past year has been 139, an increase of 22 over the year 1884 and of 46 over the year 1883.

One hundred and seventeen other analyses have been made of commercial and home-mixed fertilizers, manures and waste products used for compost, etc., making the total number of fertilizer analyses 256.

Twenty-one samples of feeding stuffs have been examined and in this connection all analyses of American feeding stuffs made during the year which were accessible have been tabulated and the results incorporated in tables to be found in this report.

Sixteen samples of seeds have been tested in the laboratory and garden.

Two samples of milk have been examined on behalf of a creamery in the State. One of these samples was found to have been watered.

Several samples of well- and spring-water have been examined.

Two cases of suspected poisoning of animals have been referred to the Station. In one case the stomach of a valuable horse was found to contain arsenic in considerable quantity.

Fourteen soil analyses have been made with the greatest care and accuracy on samples taken at different depths on the land of the Station.

Over seventy vegetation experiments in pots have been carried out but the results are not at present valuable for publication.

An extended series of experiments has been undertaken with a view of determining the solubility and indirectly the availability of different nitrogenous matters which are used in mixed fertilizers.

The Bulletins issued this year have been four in number, making in all 41 pages of printed matter.

The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mailed to every post-office in the State. The package is directed to the Postmaster, with a request to distribute to farmers. The number sent will be increased in any case on application.

The distribution of these Bulletins is of course optional with the Postmaster.

The Bulletins are also regularly sent to every newspaper in the State, and to the Secretary of each Agricultural society, Farmers' club and Grange whose address is known to the Station.

The Bulletins are regularly sent, also, on application, to any private address in Connecticut. Such application, as a rule, must be renewed annually.

To citizens of other States remitting fifty cents, the publications of the current year, including Bulletins and Annual Report, are mailed as they appear. Applications should be made early in the year.

The wish has been recently expressed that a copy of every Fertilizer Analysis should be sent, as soon as made by the Station, to each Farmers' club or local society in the State. The Director has used every endeavor to accomplish the prompt publication of the results of Station work, and has tested every method that has come to his knowledge, including the Hektograph, that promised to serve this end. Early in the year, for the first time, he obtained a Hektograph which gave the requisite number of legible copies, and thenceforth, once a week, or as soon as practicable after Fertilizer Analyses were finished, Hektograph copies were mailed to the Secretaries of all Agricultural societies, Farmers' clubs and Granges, and to the Connecticut Farmer, and were offered to such newspapers of the State as might apply for and would undertake to print them.

This arrangement will be continued in the future, and on application, Hektograph copies will also be sent to agricultural papers in other States so far as the limited supply permits.

Fourteen such "Weekly Statements" have been issued and promptly printed in the Connecticut Farmer and New England Homestead.

For convenience in printing, the subject of Fertilizers in this report follows that of Feeding Stuffs.

ANALYSES OF FEEDING STUFFS.

EXPLANATIONS CONCERNING THE ANALYSIS, VALUATION AND ECONOMICAL USE OF FEEDING STUFFS.

In order to feed animals most rationally and economically it is necessary to know:

1st. The composition of the feeding stuffs which make up their ration.

2nd. What percentage part of the different ingredients of these feeding stuffs can be digested by the animals.

3rd. How many pounds of the digestible materials must be daily supplied to each animal in order to get the maximum production of milk, of flesh, of wool, or of work; or in order to keep the animal, if at rest, simply in good condition.

I.—THE COMPOSITION OF FEEDING STUFFS.

This is determined by chemical analysis. On subsequent pages is given in tabular form the average composition of the feeding stuffs commonly used in this country, compiled exclusively from American analyses. In the first column of these tables is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

As it is very desirable to know within what limits the composition of each fodder is likely to vary, the maximum and minimum amounts of each ingredient have also been inserted in the table.

The following explanations may be helpful to the ready understanding of these tables.

EXPLANATIONS OF ANALYSES OF FEEDING STUFFS.

The analysis gives the percentage amounts of Total Dry Matter, Protein, Fat, Nitrogen-free Extract, Fiber and Ash.

Total Dry Matter is what remains of a feeding stuff when all the water it contains is removed. However dry feeding stuffs, whether hay or coarse fodder, or grain and meal, may appear to be, they always contain a considerable and variable proportion of water which is invisible and imperceptible to the senses, but which can be driven out by heat and which the perfectly dried fodder recovers more or less fully when exposed to the air. This amount of water thus present in feeding stuffs is constantly changing with the temperature and dryness of the air to which they are exposed, and accordingly no proper comparison of different foods is possible unless the proportions of water they contain is known and comparison is made on perfectly dry or water-free substance.

In the Station laboratory, water is expelled and the amount of Dry Matter determined by heating a weighed quantity of the feeding stuff at 212° Fahr. in a stream of hydrogen gas until no further loss of weight occurs.

Protein (or *Albuminoids*) is a general term which includes all those nitrogenous materials of a feeding stuff which bear a general resemblance in composition and properties to egg albumen, (white of egg) flesh fibrin, (lean meat) and milk casein, (curd.) The amount of Protein is commonly determined by multiplying the per cent. of nitrogen present by 6¼. This method is based on the fact that the protein bodies all contain not far from sixteen per cent. of nitrogen, which figure multiplied by 6¼ gives 100 per cent. or the total amount of protein corresponding to the nitrogen. Some of the albuminoids contain indeed less and some more than this per cent. of nitrogen, but, for practical purposes, the assumption of sixteen per cent. is sufficiently exact in most cases.

It is believed that the vegetable albuminoids do not greatly differ in nutritive effect or at least, since each feeding stuff commonly contains a mixture of several distinct albuminoids, the digestible portions of these various mixtures do not widely differ in nutritive value.

Besides albuminoids, certain feeding stuffs, chiefly root crops, and immature parts of plants, such as hay from young grass, contain a portion of their nitrogen in an entirely different form; as amides or amido-acids. These bodies have a different percentage composition from albuminoids, differ from them in their proper ties and very considerably in their nutritive value. They are closely related to the albuminoids, and may be derived from or assist in producing the latter.

Other nitrogenous substances which are sometimes found in certain feeding stuffs, generally in very small quantity however, are peptones, alkaloids, nitrates and ammonia salts. The last three are without any nutritive effect on animals so far as is known.

Fat includes fat oil, solid fat, wax, chlorophyl, the green coloring matter of plants, and other coloring matters, in brief everything which can be extracted from the perfectly dry feeding stuff by absolute ether.

Nitrogen-free Extract, sometimes called *Carbhydrates*, includes starch, gum, sugar and pectin bodies. They are readily extracted from the feeding stuff by water and dilute acid but their amount is always indirectly determined by subtracting the sum of the protein, fiber, fat and ash from the total dry matter.

Fiber or *Cellulose* is the essential constituent of the walls of vegetable cells and is seen in a nearly pure state in cotton fiber or paper pulp. It is the most insoluble part of the vegetable substance and its quantity is determined by boiling the feeding stuff successively with a weak acid and a weak alkali, and after copious washing with water, extracting the residue with alcohol and ether. This treatment leaves undissolved what is properly called Crude Fiber which is Cellulose in a state of comparative purity.

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air and besides a little charcoal and sand, which are accidental impurities, consists chiefly of lime, magnesia, potash and soda, combined with chlorine and carbonic, sulphuric and phosphoric acids.

The methods of fodder analysis are, in some respects, still very imperfect, as will be inferred by what has been said with regard to protein. The results, however, have proven themselves of great advantage in farm practice which is the best gauge of value and will be used until more satisfactory methods can be devised.

USE OF THE TABLES OF COMPOSITION OF FEEDING STUFFS.

These tables are designed to be a help in forming a judgment of the composition of feeding stuffs which for any reason cannot be specially submitted to chemical analysis. It follows that judgment is necessary in their use. All feed and particularly all coarse feed varies considerably in quality. The first thing to decide is whether the feed in question is in fair condition. If coarse fodder, was it raised on poor land or not, was it cut early or late, was it harvested in good order, is it clean and sweet or not? The answers to these questions will decide whether the average composition of that kind of feed can be fairly attributed to the article in hand. If it cannot be, the maximum and minimum figures will indicate how much allowance is to be made in extreme cases for specially good or unusually poor condition of the feed.

A determination of protein or of protein and crude fiber will greatly assist in the judgment, and there are few times when such determinations cannot be made within a few days if the sample is sent to the Station with notice that results are wanted for immediate use. Concentrated foods, grain, bran, etc., it will be noticed, vary much less in composition than coarse fodder. In any case the quality of the feed should be underestimated rather than overestimated.

II. The Digestibility of Feeding Stuffs.

When food is received into the stomach a portion of it is dissolved and otherwise altered by the juices of the mouth, stomach and intestines, is then taken up from the alimentary canal and in the form of chyle passes into the blood and finally becomes a part of the tissues of the body. This portion is said to be digested and assimilated and from it alone the animal is nourished. The other portions pass through the body and are excreted as dung. The urine removes from the body only certain waste products which are formed from the digested or assimilated food.

The analysis of a feeding stuff, as has been said, divides its constituents into several groups, protein, fat, etc., each of which may contain a number of substances, similar in general, yet differing in this : that some of them or portions of them are soluble in the juices of the digestive organs, i. e. are digestible, while others are not soluble, or are indigestible.

As only the soluble or digestible portion of the feeding stuff is of any nutritive use to the animal, it is essential, in order to feed rationally that it should be known of each feeding stuff what part of its protein, fat, and other ingredients—the total quantity of which is given by the analysis—is actually digested by the animal. This is learned by a feeding trial upon two or more animals. In the case of coarse fodders which can make up the entire ration during the period of experiment, the food consumed and the dung excreted are both very carefully weighed and analyzed and from their quantities and composition it is calculated how much protein, nitrogen-free extract, fiber, etc., was eaten by the animal, and how much of these several materials was voided, the difference being what was digested and served as actual nourishment. The digestibility of concentrated fodders is determined in the same way, the process being somewhat complicated and the results probably made a little less accurate because

COMPOSITION OF FEEDING STUFFS.

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
GREEN FODDER.																	
Maize fodder	36	7.10	30.89	*18.92*	.56	2.72	*1.48*	.14	.89	*.38*	3.20	19.69	*10.74*	1.90	9.78	*5.24*	1.08
Maize fodder—ensilaged	47	12.32	29.24	*19.41*	.87	2.77	*1.49*	.23	1.80	*.69*	5.12	16.49	*10.05*	4.04	10.02	*5.82*	1.37
Sorghum (amber)	3	13.62	24.96	*17.55*	1.03	1.42	*1.17*	.38	.40	*.39*	5.34	17.03	*9.31*	5.45	6.56	*5.94*	.74
Sorghum—ensilaged	5	21.97	28.08	*24.17*	.56	.94	*.75*	.14	.42	*.28*	13.83	19.02	*15.82*	5.90	6.79	*6.28*	1.04
Clover—ensilaged	2	21.44	27.40	*24.42*	3.00	3.81	*3.40*	.93	1.11	*1.02*	8.12	11.41	*9.76*	6.29	8.57	*7.43*	2.83
Cow pea vines—green and succulent, with pods	3	13.97	27.19	*19.69*	1.85	3.25	*2.70*	.21	.62	*.47*	5.34	8.46	*7.41*	2.87	15.27	*7.22*	1.89
Soja bean—whole plant	3	29.59	30.65	*30.13*	2.20	3.94	*3.34*	.87	1.55	*1.16*	14.24	16.01	*14.88*	7.93	8.91	*8.36*	2.39
Rye fodder	6	21.85	25.29	*24.72*	2.31	3.00	*2.61*	.20	.72	*.56*	4.92	12.37	*6.94*	4.92	14.89	*12.73*	1.88
Rye fodder—ensilaged	1	----	----	*19.25*	----	----	*2.42*	----	----	*.27*	----	----	*9.18*	----	----	*5.76*	1.62
Carrot leaves	1	----	----	*16.70*	----	----	*4.26*	----	----	*.86*	----	----	*5.99*	----	----	*2.25*	3.34
Beet leaves	1	----	----	*11.16*	----	----	*2.74*	----	----	*.60*	----	----	*2.49*	----	----	*2.50*	2.83
HAY AND DRY COARSE FODDER.																	
Clover hay	13	78.18	89.80	*85.35*	8.87	13.54	*11.44*	1.47	3.10	*2.02*	35.03	45.47	*39.87*	23.79	30.83	*26.69*	5.33
Hay containing much clover	8	85.43	88.63	*86.06*	6.38	14.42	*10.40*	1.50	3.09	*2.59*	35.84	45.19	*41.59*	19.66	29.53	*25.98*	5.50
High meadow hay	2	88.65	89.40	*89.02*	6.79	8.34	*7.57*	2.03	2.48	*2.25*	46.93	47.46	*47.19*	24.34	25.22	*25.78*	6.23
Timothy hay	32	85.70	93.50	*88.81*	4.27	9.60	*6.02*	1.08	3.30	*2.20*	41.09	58.52	*46.26*	22.70	37.11	*30.35*	3.98
Timothy and red top	8	84.78	91.80	*86.55*	5.14	8.97	*6.66*	1.45	2.70	*2.10*	39.20	48.90	*28.69*	24.72	33.33	*28.69*	4.99
Mixed meadow grasses	2	----	----	*85.7**	----	----	*6.76*	----	----	*1.53*	----	----	*46.16*	----	----	*26.85*	4.39
Hungarian grass hay	8	----	----	*83.3**	----	----	*6.59*	----	----	*1.81*	----	----	*42.49*	----	----	*27.16*	5.24
Low meadow hay	10	85.50	93.60	*89.50*	4.60	10.40	*7.70*	.70	3.60	*2.20*	39.80	55.20	*43.60*	21.40	40.00	*30.20*	5.80
Salt marsh hay	11	81.40	92.80	*89.53*	4.30	7.80	*5.90*	1.63	3.10	*2.32*	34.10	53.67	*42.42*	27.00	37.90	*31.47*	7.42

*** Calculated to same water content.**

COMPOSITION OF FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
HAY AND DRY COARSE FODDER—*continued.*																	
Black grass hay*	2	88.98	91.06	*90.02*	6.56	7.06	*6.81*	2.28	2.38	*2.33*	43.14	49.31	*46.26*	24.63	29.42	*27.01*	7.60
Maize fodder—field cured	6	60.63	77.07	*67.95*	3.39	4.97	*4.29*	.66	1.56	*1.24*	30.52	40.82	*35.96*	18.65	25.18	*22.14*	4.32
Buckwheat straw	2	89.50	89.60	*89.55*	3.33	4.38	*3.85*	1.42	1.70	*1.56*	32.08	34.49	*33.28*	44.93	46.83	*45.88*	5.05
Oat straw	3	87.50	93.47	*89.89*	2.30	5.08	*3.35*	1.00	3.15	*2.07*	26.42	44.26	*36.97*	35.21	55.96	*42.78*	4.72
Rye straw	2	87.50	90.27	*88.89*	2.19	6.89	*4.54*	1.00	2.68	*1.84*	35.70	41.04	*38.37*	34.20	43.29	*38.75*	1.84
Wheat straw	1	----	----	*93.50*	----	----	*4.98*	----	----	*1.49*	----	----	*41.99*	---	----	*38.08*	6.96
Cow pea vines	6	86.01	90.70	*88.95*	13.56	19.81	*15.68*	1.13	4.05	*2.87*	34.98	46.40	*42.17*	17.20	23.66	*19.82*	8.41
ROOTS, BULBS, TUBERS AND OTHER VEGETABLES AND FRUITS.																	
Beets—red	2	10.54	12.32	*11.43*	1.48	1.73	*1.60*	.14	.21	*.18*	7.16	7.64	*7.40*	.64	1.69	*1.16*	1.08
Beets—sugar	4	9.24	15.58	*11.95*	1.69	1.89	*1.78*	.05	.08	*.06*	5.67	11.75	*8.31*	.71	.93	*.82*	.98
Mangolds	3	7.18	8.56	*7.96*	1.57	1.89	*1.71*	.03	.51	*.20*	3.56	4.91	*4.18*	.76	.91	*.82*	1.05
Ruta bagas	1	----	----	*12.92*	----	----	*1.15*	----	----	*.09*	----	----	*9.11*	----	---	*1.16*	1.41
Turnips	1	----	----	*11.11*	----	----	*1.34*	----	----	*.09*	----	----	*8.11*	----	----	*.86*	0.71
Carrots	3	12.15	13.48	*12.94*	.84	1.99	*1.26*	.20	.71	*.52*	6.86	10.40	*8.32*	.99	2.32	*1.62*	1.22
Onions	6	6.48	18.43	*12.45*	.77	2.28	*1.41*	.22	.36	*.26*	3.77	14.09	*9.53*	.59	.76	*.69*	.56
Potatoes	5	19.61	23.80	*21.45*	1.14	2.50	*1.95*	.02	.14	*.09*	15.33	19.91	*17.99*	.28	.85	*.56*	.86
Sweet potatoes	3	26.61	34.04	*29.72*	.45	1.28	*.98*	.28	.36	*.32*	23.00	29.72	*26.13*	.60	2.50	*1.36*	.93
Yam	1	----	----	*28.77*	----	----	*2.06*	----	----	*.25*	----	----	*25.24*	----	----	*.70*	.67
Apples	2	15.89	22.70	*19.30*	.21	.50	*.35*	.28	.41	*.35*	14.26	19.96	*17.11*	.91	1.37	*1.14*	.35
Cucumbers	2	3.71	4.30	*4.01*	.79	.83	*.81*	.21	.22	*.22*	1.72	1.95	*1.84*	.53	.85	*.69*	.45

* *Juncus Gerardi.*

COMPOSITION OF FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
ROOTS, BULBS, TUBERS, &C.—*continued.*																	
Squashes	2	4.82	5.42	*5.12*	.64	.68	*.66*	.24	.32	*.28*	2.95	3.54	*3.24*	.53	.54	*.54*	.40
Tomatoes	1	----	----	*8.74*	----	----	*1.00*	----	----	*.47*	----	----	*5.84*	----	----	*.70*	.73
Peas	1	---	----	*21.94*	----	----	*4.37*	----	----	*.55*	----	----	*14.48*	----	----	*1.66*	.88
String beans	1	----	----	*16.54*	----	----	*2.75*	----	----	*.34*	----	----	*10.04*	----	----	*2.58*	.83
Cabbage	1	----	----	*6.41*	----	----	*2.01*	----	----	*.19*	----	----	*2.00*	----	----	*1.44*	.72
Cauliflower	1	----	----	*9.18*	----	----	*1.62*	----	----	*.79*	---	----	*4.94*	----	----	*1.02*	.81
GRAIN AND OTHER SEEDS.																	
Buckwheat	8	85.10	89.10	*87.40*	8.60	11.00	*10.00*	2.20	2.40	*2.25*	62.60	65.40	*64.50*	7.80	9.40	*8.70*	2.00
Barley	9	87.43	92.77	*89.08*	8.59	15.73	*12.39*	1.49	3.15	*1.86*	66.72	73.91	*69.88*	1.28	4.17	*2.57*	2.38
Oats	21	86.50	91.10	*89.30*	8.00	14.40	*11.30*	4.10	5.80	*5.00*	57.10	66.90	*61.00*	1.50	12.90	*9.00*	3.00
Rye	6	86.80	91.30	*88.40*	9.50	12.10	*10.60*	1.40	2.10	*1.70*	70.70	73.90	*72.60*	1.40	2.10	*1.60*	1.90
Wheat—winter	240	83.77	92.90	*89.47*	8.25	16.63	*11.73*	1.26	3.93	*2.12*	68.08	76.64	*71.99*	.44	2.87	*1.77*	1.86
Wheat—spring	13	86.65	91.88	*89.63*	8.14	15.40	*12.51*	1.82	2.56	*2.20*	66.07	78.66	*71.19*	1.33	2.30	*1.82*	1.91
Wheat—unclassified	54	87.62	90.64	*89.28*	9.80	14.70	*11.97*	1.64	2.83	*2.09*	68.52	74.65	*71.49*	1.21	3.05	*1.91*	1.82
Wheat—average of all analyses	307	83.77	92.90	*89.45*	8.14	16.63	*11.86*	1.26	3.93	*2.10*	66.07	78.66	*71.87*	.44	3.05	*1.79*	1.83
Maize—dent	78	85.95	93.78	*89.90*	7.53	12.07	*10.34*	3.80	6.93	*5.13*	66.26	75.73	*70.59*	1.25	4.81	*2.29*	1.55
Maize—flint	69	81.84	93.41	*88.92*	7.00	13.65	*10.60*	3.40	7.13	*4.92*	64.95	74.62	*70.34*	.67	2.88	*1.63*	1.43
Maize—sweet	25	89.14	94.02	*91.27*	9.45	15.31	*11.63*	5.25	11.89	*8.32*	61.78	72.35	*66.58*	1.46	5.24	*2.82*	1.92
Maize—" western corn "	3	79.30	83.60	*80.90*	7.80	8.60	*8.30*	3.60	3.90	*3.70*	64.90	68.20	*66.00*	1.70	1.80	*1.75*	1.20
Maize—average of all analyses	184	79.30	94.02	*89.46*	7.00	15.31	*10.59*	3.40	11.89	*5.49*	61.78	75.73	*69.73*	.67	5.24	*2.10*	1.55
Sorghum seed	9	83.24	90.72	*87.48*	7.67	11.25	*8.88*	2.12	4.60	*3.65*	66.81	73.59	*71.27*	1.48	3.21	*1.88*	1.80
Cotton seed—hulls and kernel	1	----	----	*92.28*	----	----	*15.72*	----	----	*18.56*	----	----	*29.09*	----	----	*25.75*	3.16

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Grain and other Seeds—*continued.*																	
Cow pea	5	79.20	89.99	*85.21*	19.30	23.00	*20.77*	1.30	1.60	*1.43*	48.10	61.99	*55.75*	3.37	5.00	*4.06*	3.20
Doura—brown	3	87.30	92.40	*89.00*	9.00	11.50	*10.30*	----	----	*4.20*	----	----	*69.90*	----	----	*1.50*	1.60
Soja bean	3	89.87	93.95	*91.41*	34.63	38.62	*36.22*	16.80	19.00	*17.92*	26.20	30.50	*28.66*	3.69	5.00	*4.24*	4.37
Flour and Meal.																	
Barley meal	3	83.80	86.00	*84.90*	8.80	13.90	*11.80*	.70	2.20	*1.70*	----	----	*70.90*	----	----	*.10*	.50
Buckwheat flour	3	85.06	87.22	*86.48*	4.18	8.00	*6.48*	.65	1.74	*1.33*	75.81	79.37	*77.34*	.21	.35	*.28*	1.05
Oat meal	6	91.16	93.77	*92.15*	12.87	16.25	*14.66*	6.05	8.77	*7.06*	66.62	68.99	*67.57*	.64	1.15	*.86*	2.00
Rye flour	4	86.42	87.65	*86.90*	6.00	7.05	*6.65*	.78	.89	*.84*	77.56	79.09	*78.28*	.35	.45	*.41*	.72
Wheat flour—from winter wheat*	1	----	----	*87.04*	----	----	*8.56*	----	----	*1.19*	----	----	*76.59*	----	----	*.17*	.53
Wheat flour—from spring wheat†	6	86.50	89·70	*87.68*	8.56	14.12	*10.68*	.56	2.01	*1.11*	68.32	78.11	*75 00*	.00	1.22	*.22*	.64
Wheat flour—unclassified	17	86.83	88.81	*87.54*	9.69	13.31	*11.28*	.81	1.88	*1.15*	69.52	76.93	*74.43*	.06	.99	*.16*	.52
Wheat flour—average of all analyses	24	86.50	89.70	*87.56*	8.56	14 12	*11.01*	.56	2.01	*1.14*	68.32	78.11	*74.67*	.00	1.22	*.18*	.56
Graham flour	3	86.30	87.90	*86.90*	11.30	12.40	*11.70*	1.50	1.90	*1.70*	69.80	70.00	*69.80*	1.80	2.00	*1.90*	1.80
Maize meal	34	75.46	90.14	*84.97*	7.11	13.94	*9.09*	2.23	4.63	*3.72*	60.72	73.96	*68.86*	.50	2.99	*1.85*	1.45
Hominy	2	86.38	86.64	*86.51*	8.08	8.41	*8.25*	.42	.46	*.44*	77.07	77.18	*77.12*	.31	.33	*.32*	.38
By-Products and Refuse.																	
Apple pomace	3	22.80	27.40	*25.90*	1.00	1.70	*1.40*	1.70	2.00	*1.90*	15.70	17.00	*16.70*	3.90	5.90	*5.20*	.70
Brewers' grains—from brewery	15	20.59	31.40	*24.99*	4.27	7.75	*5.57*	.79	2.94	*1.68*	10.11	15.73	*12.86*	3.05	5.58	*3.87*	1.01
Brewers' grains—" dried "	3	88.09	93.77	*91.81*	19.25	20.25	*19.89*	4.17	6.51	*5.56*	46.10	56.80	*51.75*	10.24	11.60	*11.01*	3.58
Brewers' grains—kiln-dried	1	----	----	*97.43*	----	----	*20.30*	----	----	*6.40*	----	----	*54.89*	----	----	*11.79*	3.97
Brewers' grains—from silo	3	26.14	33.23	*30.18*	5.85	7.14	*6.64*	1.79	2.57	*2.11*	13.65	16.86	*15.58*	3.89	5.43	*4.64*	1.21
Brewers' swill	1	----	----	*5.70*	----	----	*1.90*	----	----	*.80*	----	----	*2.00*	----	----	*.70*	.30

*** The average of 18 analyses, most of them incomplete is: Total dry matter, 89.63; Ash, .64; Protein, 10.92.**

† The average of 16 analyses, most of them incomplete is: Total dry matter, 88.55; Ash, .60; Protein, 11.63.

Composition of Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Protein.			Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
By Products and Refuse—*continued.*																	
Malt sprouts	3	88.03	92.69	*89.73*	21.00	25.91	*22.95*	1.09	2.98	*1.79*	45.47	50.30	*48.60*	9.30	11.99	*10.72*	5.67
Cotton seed meal	24	81.48	94.22	*91.67*	23.27	50.80	*42.06*	10.24	18.00	*13.24*	12.74	38.68	*23.43*	2.77	11.76	*5.69*	7.25
Linseed cake	4	89.20	91.65	*89.98*	31.81	34.93	*33.77*	4.00	6.06	*5.04*	33.44	39.11	*36.68*	7.97	9.36	*8.52*	5.97
Linseed meal—old process	4	90.00	93.83	*91.66*	27.68	32.43	*30.80*	8.20	11.57	*10.12*	31.29	41.89	*34.75*	7.26	12.90	*10.01*	5.98
Linseed meal—new process	12	86.65	93.21	*89.88*	27.12	37.10	*32.94*	1.30	6.83	*3.57*	36.54	48.03	*38.35*	7.12	13.99	*9.09*	5.93
Palm nut meal	3	89.16	93.86	*91.71*	13.53	16.01	*14.39*	6.41	18.73	*13.30*	33.85	41.66	*38.88*	18.75	23.98	*21.40*	3.74
Rye bran	3	86.30	89.70	*87.70*	12.60	16.80	*15.26*	1.79	2.60	*2.19*	59.75	67.00	*63.12*	2.50	4.10	*3.51*	3.62
Wheat bran	30	85.72	91.76	*87.92*	7.50	16.89	*14.82*	2.39	5.84	*3.67*	50.41	58.93	*55.04*	5.98	16.64	*8.55*	5.84
Wheat middlings	11	86.15	90.75	*88.37*	10.13	16.50	*12.92*	2.07	5.87	*3.51*	60.21	70.86	*64.65*	1.27	7.62	*4.61*	2.68
Wheat shorts	6	86.41	89.04	*88.15*	11.13	15.13	*13.14*	2.50	4.85	*3.79*	55.62	62.32	*58.96*	6.34	10.47	*7.94*	4.32
"Hominy chops," "hominy feed," "Baltimore meal," "white meal"	9	86.54	91.89	*88.59*	7.88	10.81	*9.61*	4.45	11.23	*8.17*	60.95	71.10	*64.82*	2.54	4.79	*3.56*	2.43
Gluten meal	6	88.32	92.69	*90.70*	24.95	35.00	*29.62*	3.49	8.73	*5.69*	44.72	58.53	*53.10*	.68	3.25	*1.54*	.75
Maize cob	13	85.58	92.82	*90.67*	1.23	3.73	*2.50*	.08	.92	*.47*	45.31	66.38	*55.99*	28.23	38.26	*30.36*	1.33
"Starch feed"—refuse from starch manufacture	5	27.81	37.73	*33.51*	3.56	6.55	*5.24*	1.31	3.97	*2.53*	18.69	28.90	*22.68*	1.58	4.34	*2.84*	.22
"Sugar feed"—refuse from glucose manufacture	2	89.60	93.40	*91.50*	13.10	13.50	*13.30*	5.90	11.20	*8.60*	54.90	61.40	*58.10*	8.40	10.70	*9.50*	2.00
"Glucose waste"—wet	1	----	----	*24.00*	----	----	*3.72*	----	----	*1.63*	----	----	*17.39*	----	----	*.75*	.51
Sorghum meal—from seed mostly decorticated	1	----	----	*86.84*	----	----	*8.25*	----	----	*3.85*	----	----	*71.27*	----	----	*1.88*	1.59
Sorghum bagasse	3	11.30	16.60	*14.50*	.62	.68	*.65*	----	----	....	----	----	*10.20*	2.80	3.30	*3.10*	.60

the concentrated foods cannot be fed by themselves but must be administered in connection with a coarse fodder whose digestibility has already been determined.

Many practical trials have been made, chiefly at German experiment stations, to determine accurately the digestibility of the feeding stuffs commonly in use. The larger number of trials were made with cattle and sheep, some also with horses and swine. Some of the results of these trials are given in the following table of the Digestibility of Feeding Stuffs or of Digestion Coefficients. This is made up in large part from the one given in Mentzel and Lengerke's Landw. Kalender, 1885. Use has also been made of the tables in Dr. H. P. Armsby's Manual of Cattle Feeding. The arrangement of the table is simple. Thus the figure 3 after pasture grass in the first column signifies the number of distinct lots of pasture grass which were tested. In the next column 6 means that with the three separate lots of pasture grass six distinct feeding experiments were made with ruminating animals : sheep, cows and oxen. The greater the number of experiments and lots of grass tested the more accurately will the average digestibility be determined. 77 in the fifth column indicates that of the dry organic substance contained in pasture grass, the ruminants digest on the average 77 per cent. or $\frac{770}{1000}$, while the maximum and minimum figures 78 and 75 mean that one of the three samples of hay tested had but 75 per cent. and another had as high as 78 per cent. of its organic substance digested. By use of the information given in the tables of the Composition and the Digestibility of Feeding Stuffs it is easy for the farmer to ascertain with reasonable accuracy how much real nutriment is at his disposal for stock feeding.

A single example may illustrate. It is required to know how much digestible food is contained in a ton of wheat bran. By reference to the table of Composition of Feeding Stuffs it is seen that wheat bran has the following average composition :

Dry matter	87.92
Protein	14.82
Fat	3.67
Nitrogen-free extract	55.04
Fiber	8.55
Ash	5.84

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients).

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
GREEN FODDER.																	
Pasture grass	3	6	75	78	*77.*	72	79	*75.*	63	69	*66.*	75	84	*78.*	72	80	*75.*
Meadow grass [experiments with horses]	10	13	43	62	*50.*	54	69	*61*	9	42	*21.*	49	66	*57.*	33	57	*41.*
Meadow rowen	6	30	62	71	*64.*	61	68	*62.*	31	56	*46.*	63	74	*66.*	59	68	*64.*
Pasture clover, very young	1	2	--	--	*75.*	--	--	*78.*	--	--	*64.*	--	--	*78.*	--	--	*67.*
Red clover, just before blossoming	6	15	59	74	*66.*	60	76	*66.*	58	74	*64.*	63	83	*73.*	47	60	*53.*
Lucerne, before flowering and in flower	9	28	55	67	*60.*	67	83	*74.*	29	55	*39.*	61	73	*67.*	34	48	*43.*
Vetches*	--	--	--	--	--	73	80	*76.*	50	66	*60.*	63	67	*65.*	51	58	*54.*
Lupines*	--	--	--	--	--	73	76	*74.*	16	45	*30.*	57	66	*62.*	67	80	*73.*
Maize fodder (very good)	1	1	--	--	*70.*	--	--	*73.*	--	--	*75.*	--	--	*67.*	--	--	*72.*
Sorghum	1	1	--	--	*73.*	--	--	*62.*	--	--	*85.*	--	--	*78.*	--	--	*59.*
Beet leaves [ensilaged]	1	2	--	--	*57.*	--	--	*65.*	--	--	*60.*	--	--	*54.*	--	--	*54.*
Beans, peas, cabbage, turnip leaves, parsnip leaves	--	--	--	--	--	--	--	*71.*	--	--	*60.*	--	--	*100†*	--	--	--
Fodder rye, fodder oats, beet leaves, carrot leaves, buckwheat	--	--	--	--	--	--	--	*58.*	--	--	*46.*	--	--	*100†*	--	--	--
HAY.																	
Meadow hay	38	104	46	71	*62.*	42	72	*62.*	10	63	*52.*	49	76	*64.*	46	71	*57.*
Meadow hay (very good)	14	42	56	71	*65.*	57	70	*64.*	31	63	*50.*	58	76	*68.*	55	71	*62.*
Meadow hay (medium)	24	62	46	69	*60.*	42	72	*57.*	10	63	*48.*	49	73	*62.*	46	66	*58.*

* These co-efficients were obtained in experiments with very good hay of these plants but are approximately correct for the green fodder.

† The number 100 indicates that the sum of the digestible extract and fiber is equal to the total amount of nitrogen-free extract.

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
HAY—*continued.*																	
Meadow hay (inferior)	7	18	46	59	*55.*	42	56	*51.*	10	57	*41.*	49	61	*58.*	46	61	*54.*
Meadow hay (very good, experiments on horse)	3	4	49	55	*52.*	63	66	*64.*	14	42	*24.*	52	62	*57.*	36	46	*43.*
Meadow hay (medium, experiments on horse)	5	6	43	51	*48.*	54	62	*58.*	16	33	*23.*	49	61	*55.*	33	40	*37.*
Clover hay [very good]	6	12	58	63	*61.*	55	69	*62.*	44	72	*60.*	67	72	*70.*	39	52	*47.*
Clover hay (medium)*	6	19	54	62	*57.*	43	61	*55.*	35	70	*51.*	58	67	*65.*	39	52	*45.*
Clover hay (experiments on horse)	4	6	49	55	*51.*	51	60	*56.*	28	31	*29.*	61	67	*64.*	35	39	*37.*
Lucerne hay (very good)	9	28	55	67	*60.*	67	83	*74.*	29	55	*39.*	61	73	*66.*	34	48	*43.*
Hay of fodder vetches [before blossom]	1	6	--	--	*65.*	--	--	*76.*	--	--	*60.*	--	--	*66.*	--	--	*54.*
Lupine hay, in blossom	1	2	--	--	--	--	--	*74.*	--	--	*30.*	--	--	*62.*	--	--	*74.*
ROOTS.																	
Potatoes	3	23	83	90	*88.*	64	67	*65.*	--	--	--	89	96	*93.*	--	--	--
Potatoes [experiments with pigs]	5	8	--	--	*93.*	--	--	*73.*	--	--	--	--	--	*98.*	--	--	*55.*
Sugar beets	2	28	84	93	*89.*	56	68	*62.*	--	--	--	95	96	*95.*	--	--	--
Mangolds	2	16	87	88	*88.*	66	86	*76.*	--	--	--	94	96	*95.*	--	--	--
Turnips	1	8	--	--	*78.*	--	--	*57.*	--	--	--	--	--	*89.*	--	--	--
GRAINS.																	
Oats	6	31	62	74	*68.*	68	86	*77.*	75	97	*82.*	67	79	*74.*	0	26	*17.*
Oats (experiment with horse)	1	5	--	--	*72.*	--	--	*86.*	--	--	*78.*	--	--	*76.*	--	--	*24.*
Barley	1	2	--	--	*81.*	--	--	*77.*	--	--	*100.*	--	--	*87.*	--	--	--

* The digestibility of clover hay may serve as a basis for determining that of hay of other legumes, and the digestibility of meadow hay for determining that of hay from the cultivated grasses.

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
GRAINS—*continued.*																	
Barley (experiment with horse)	1	1	--	--	*87.*	--	--	*80.*	--	--	*42.*	--	--	*87.*	--	--	*100.*
Barley (experiments with pig)	4	8	82	85	*83.*	75	80	*78.*	65	77	*68.*	89	91	*90.*	0	27	*12.*
Maize	1	2	--	--	*89.*	--	--	*79.*	--	--	*85.*	--	--	*91.*	--	--	*62.*
Maize (experiment with horse)	1	1	--	--	*91.*	--	--	*78.*	--	--	*63.*	--	--	*94.*	--	--	*100.*
Maize (experiments with pig)	3	4	90	95	*92.*	84	88	*86.*	76	77	*76.*	93	96	*95.*	19	57	*40.*
Field beans	5	18	83	94	*89.*	81	95	*88.*	65	100	*87.*	88	95	*92.*	25	92	*72.*
Field beans (experiments with horse)	1	4	--	--	*87.*	--	--	*86.*	--	--	--	--	--	*93.*	--	--	*69.*
Peas	1	2	--	--	*90.*	--	--	*89.*	--	--	*75.*	--	--	*93.*	--	--	*66.*
Peas (experiment with horse)	1	1	--	--	*80.*	--	--	*83.*	--	--	*67.*	--	--	*89.*	--	--	*8.*
Peas (experiments with pigs)	5	10	88	95	*91.*	85	90	*88.*	36	67	*49.*	95	99	*96.*	55	89	*71.*
BY-PRODUCTS AND REFUSE.																	
Wheat bran (fed dry)	5	12	67	78	*72.*	71	89	*78.*	50	80	*69.*	70	82	*77.*	20	39	*33.*
Rye bran [experiments with pigs]	1	2	--	--	*67.*	--	--	*66.*	--	--	*58.*	--	--	*75.*	--	--	*4.*
Malt sprouts	1	3	--	--	*84.*	--	--	*82.*	--	--	*49.*	--	--	*88.*	--	--	*95.*
Brewers' grains	1	2	--	--	*63.*	--	--	*73.*	--	--	*84.*	--	--	*64.*	--	--	*39.*
Rape meal (oil extracted)	1	1	--	--	*68.*	--	--	*84.*	--	--	--	--	--	*85.*	--	--	--
Rape cake	2	7	56	75	*66.*	76	86	*81.*	69	88	*79.*	74	78	*76.*	0	16	*8.*
Linseed meal [oil extracted]	1	8	--	--	*71.*	--	--	*82.*	--	--	*91.*	--	--	*73.*	--	--	--
Linseed cake	2	10	78	83	*81.*	84	87	*86.*	89	91	*90.*	70	91	*80.*	26	62	*44.*

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Protein.			Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
BY-PRODUCTS AND REFUSE—*continued.*																	
Palm-nut meal (oil extracted)	2	3	89	93	*91.*	89	100	*95.*	89	100	*95.*	92	96	*94.*	72	92	*82.*
Cotton-seed cake (decorticated)	1	2	..	..	*80.*	..	..	*85.*	..	..	*88.*	..	..	*95.*	..	..	..
Cotton-seed cake (not decorticated)	1	4	..	..	*50.*	..	..	*73.*	..	..	*91.*	..	..	*46.*	..	..	*23.*
Cocoanut cake	1	2	..	..	*78.*	..	..	*76.*	..	..	*100*	..	..	*81.*	..	..	*62.*
Cocoanut cake [experiments with pigs]	1	2	..	..	*80.*	..	..	*74.*	..	..	*83.*	..	..	*89.*	..	..	*60.*
Flesh meal	1	2	..	..	*95.*	..	..	*95.*	..	..	*98.*	..	..	..	..	..	..
Flesh meal [experiments with pigs]	1	8	..	..	*95.*	..	..	*97.*	..	..	*87.*	..	..	..	..	..	..
Blood meal	1	2	..	..	*63.*	..	..	*62.*	..	..	*100*	..	..	*100*	..	..	..
Blood meal [experiments with pig]	1	1	..	..	*72.*	..	..	*72.*	..	..	..	..	..	*92.*	..	..	..
Fish guano	1	2	..	..	..	..	..	*90.*	..	..	*76.*	..	..	..	..	..	..
STRAW.																	
Wheat straw*	2	3	45	48	*46.*	8	26	*17.*	27	44	*36.*	37	40	*39.*	52	59	*56.*
Wheat straw [experiments with horse]	1	2	..	..	*23.*	..	..	*19.*	..	..	*49.*	..	..	*17.*	..	..	*27.*
Rye straw	2	9	42	51	*46.*	17	25	*21.*	..	..	*32.*	35	38	*37.*	49	70	*60.*
Oat straw	4	8	48	56	*51.*	24	48	*41.*	20	49	*30.*	39	45	*46.*	55	64	*60.*
Barley straw	2	5	51	55	*53.*	17	24	*20.*	41	43	*42.*	51	57	*54.*	55	56	*56.*
Pea straw (very good)	1	2	..	..	*59.*	..	..	*61.*	..	..	*46.*	..	..	*64.*	..	..	*52.*
Bean straw*	1	3	..	..	*50.*	..	..	*51.*	..	..	*55.*	..	..	*63.*	..	..	*36.*
Lupine straw	1	2	..	..	*55.*	..	..	*37.*	..	..	*30.*	..	..	*65*	..	..	*51.*

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* The coefficients of wheat straw may also be applied to stover and those of bean straw to vetch straw.

The table of the Digestibility of Feeding Stuffs shows that in wheat bran about

78 per cent. of the protein,
69 per cent. of the fat,
77 per cent. of the nitrogen-free extract,
33 per cent. of the fiber,

are digested by oxen.

Multiplying the total amounts of the different constituents as expressed in per cent. or pounds per hundred by their percentage digestibility or " digestion coefficients " gives the actual amounts of digestible matter in 100 pounds of the bran, and this again multiplied by 20 will give the amounts of *digestible* protein, fat, etc., in 2000 pounds or one ton.

Digestible protein............	14.82 × .78=11.56 × 20=231.2
Digestible fat...............	3.67 × .69= 2.53 × 20= 50.6
Digestible N.-free extract	55.04 × .77=42 38 × 20=847.6
Digestible fiber.............	8.55 × .33= 2.82 × 20= 56.4

By precisely the same method the actual nutriment of all the feeding stuffs used may be determined with sufficient accuracy.

The next step is to compound from these materials a ration which shall supply the animal with sufficient but not a wasteful excess of the different kinds of nutriment. With regard to the use of these various nutrients in the animal body it may be said that protein has a different physiological significance from fiber and the nitrogen-free extract, which latter consists of starch, the sugars, the gums and similarly constituted matters.

Protein may easily be made over by the animal into its own substance, i. e., into muscles, tendons and the various working tissues and membranes which are necessary parts of the animal machine, because it is made up of the same kind of materials, is, chemically speaking, of the same composition.

Fiber and the nitrogen-free extract on the other hand, probably cannot serve at all for building up the muscles and other parts of the growing animal and cannot restore the waste and wear of those parts of mature animals, because they are of a very different nature. They contain no nitrogen, an element which enters into all the animal tissues (albuminoids) to the extent of some sixteen per cent. of their dry matter.

Fiber and the N.-free extract cannot restore the worn out muscles or membranes of the animal any more than coal can be made to renew the used-up packing, bolts, valves, flues and gearing of a steam-engine. Protein is to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

Fat, fiber and N.-free extract are, furthermore, to the animal very much what coal and fuel are to the steam-engine. Their consumption generates the power which runs the mechanism. Their burning (oxidation) in the blood of animals produces the results of life just as the combustion of coal in the fire-place of the steam-engine produces the motion and power of that machine.

There is, however, this difference between the engine and the animal. The former may be stopped for repairs, the latter may run at a lower rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its wastes. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed not only with coal and water, but with iron, brass and all the materials for its repair, and also is as if the engine consumed its own worn out parts, voiding them as ashes or as gas and smoke. Protein or the blood- and tissue-former is thus consumed in the animal, as well as the fat, fiber and N.-free extract or fuel proper. The fact that protein admits of consumption implies that when the proper fuel is insufficient, protein may itself serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has demonstrated, that for each special case of animal nutrition a special ratio of digestible protein to digestible fat, fiber and N.-free extract is the best and most economical, and, within certain limits, is necessary. This proportion we designate as the *nutritive ratio*, and these explanations make its significance evident.

It is believed that the digestible parts of fiber and of N.-free extract (i. e., of starch, sugar, and gums), have about the same nutritive value, i. e. answer essentially the same purposes in the body. The fat, however, has a greater value, formerly assumed to be two and a half times that of fiber and N.-free extract. This assumption is not entirely justified by our present knowledge, yet for the sake of uniformity and to avoid confusion, that factor must be retained till a more satisfactory one is agreed upon.

The rule then to determine the nutritive ratio in any feeding stuff or ration is to add together the amounts of digestible fiber and N.-free extract, and the amount of digestible fat multiplied by 2½ and divide that sum by the amount of digestible protein.

To illustrate: the nutritive ratio of the wheat bran, whose digestible nutrients are given above, is calculated as follows:

Digestible fiber	2.82
" nitrogen-free extract	42.38
" fat (2.53) × 2½	6.32
	51.52

51.52 + 11.56 = digestible protein = 4.46

Thus the nutritive ratio of wheat bran is 1 : 4.46.

III. Feeding Standards.

In the last paragraphs a comparison has been made between the animal and a steam engine. It is evident that the engine must be fed with sufficient fuel of a kind adapted for use in its furnace and beside this, to run it economically the amount of fuel and the rate of feeding it must be adapted to the work to be performed. If the engine is simply standing in readiness, with steam up, a very little fuel will do, if it is propelling a locomotive and approaching a steep grade with a heavy train the consumption of fuel must be enormously increased. The same holds with the animal machine: the amount of food must be suited to the performance required.

But the locomotive engine does a single kind of work; domestic animals on the contrary do several kinds—they produce beside animal heat, either flesh, milk, wool or muscular energy.

Not only is the total amount of food required for these various kinds of production different but, as experience proves, different proportions of the various digestible food-elements or nutrients are required to yield fat mutton than are needed to produce milk, or to sustain labor, or to keep the resting animal in fair condition; and again the most suitable milk-producing ration is not the one best adopted for the growth of wool.

A careful observant feeder of cattle by long trial can ascertain with approximate correctness in what quantity and proportion he can most profitably use the feeding stuffs which are at his command. His results may be adopted by his neighbors with profit provided that their feeding materials are of the same kind and of the same quality, but if their feed is different, if one is using early cut hay, the other late cut hay, if one uses corn meal, the other wheat bran, if one has mangolds at his disposal, the other not, then the valuable experience of the one is of comparatively little use to the other. Some common standard of comparison is necessary in order to make the experience of one readily available for others. The best means of comparison as yet realized, is furnished by the table of Feeding Standards taken in connection with the other tables which have been already explained.

TABLE OF FEEDING STANDARDS.

A. POUNDS PER DAY PER 1,000 POUNDS LIVE WEIGHT.

KIND OF ANIMAL.	Total organic matter.	Protein.	Nitrogen-free extract and fiber.	Fat.	Total nutritive substances.	Nutritive ratio.
Horse at light work	21.0	1.5	9.5	0.40	11.40	1 : 7.0
" average work	22.5	1.8	11.2	0.60	13.60	1 : 7.0
" hard work	25.5	2.8	13.4	0.80	17.00	1 : 5.5
Oxen at rest in stall	17.5	0.7	8.0	0.15	8.85	1 : 12.0
" ordinary work	24.0	1.6	11.3	0.30	13.20	1 : 7.5
" hard work	26.0	2.4	13.2	0.50	16.10	1 : 6.0
Oxen fattening, first period	27.0	2.5	15.0	0.50	18.00	1 : 6.5
" " second "	26.0	3.0	14.8	0.70	18.50	1 : 5.5
" " third "	25.0	2.7	14.8	0.60	18.10	1 : 6.0
Milk Cows	24.0	2.5	12.5	0.40	15.40	1 : 5.4
Sheep, wool-producing (coarser breeds)	20.0	1.2	10.3	0.20	11.70	1 : 9.0
" wool-producing (finer breeds)	22.5	1.5	11.4	0.25	13.15	1 : 8.0
" fattening, first period	26.0	3.0	15.2	0.50	18.70	1 : 5.5
" " second "	25.0	3.5	14.4	0.60	18.50	1 : 4.5
Swine, fattening, first period	36.0	5.0	27.5		32.50	1 : 5.5
" " second "	31.0	4.0	24.0		28.00	1 : 6.0
" " third "	23.5	2.7	17.5		20.20	1 : 6.5
GROWING CATTLE.						
Age, Months. — Average live weight per head.						
2–3 — 150 pounds	22.0	4.0	13.8	2.0	19.8	1 : 4.7
3–6 — 300 "	23.4	3.2	13.5	1.0	17.7	1 : 5.0
6–12 — 500 "	24.0	2.5	13.5	0.6	16.6	1 : 6.0
12–18 — 700 "	24.0	2.0	13.0	0.4	15.4	1 : 7.0
18–24 — 850 "	24.0	1.6	12.0	0.3	13.9	1 : 8.0
GROWING SHEEP.						
5–6 — 56 pounds	28.0	3.2	15.6	0.8	19.6	1 : 5.5
6–8 — 67 "	25.0	2.7	13.3	0.6	16.6	1 : 5.5
8–11 — 75 "	23.0	2.1	11.4	0.5	14.0	1 : 6.0
11–15 — 82 "	22.5	1.7	10.9	0.4	13.0	1 : 7.0
15–20 — 85 "	22.0	1.4	10.4	0.3	12.1	1 : 8.0
GROWING PIGS.						
2–3 — 50 pounds	42.0	7.7	30.0		37.5	1 : 4.0
3–5 — 100 "	34.0	5.0	25.0		30.0	1 : 5.0
5–6 — 125 "	31.5	4.3	23.7		28.4	1 : 5.5
6–8 — 170 "	27.0	3.4	20.4		23.8	1 : 6.0
8–12 — 250 "	21.0	2.5	16.2		18.7	1 : 6.5

TABLE OF FEEDING STANDARDS—*Continued.*

B. POUNDS PER DAY AND HEAD.

KIND OF ANIMAL.		Total organic matter.	Protein.	Nitrogen-free extract and fiber.	Fat.	Total nutritive substances.	Nutritive ratio.
	GROWING CATTLE.						
2–3	150 pounds	3.3	0.6	2.1	0.30	3.00	1 : 4.7
3–6	300 "	7.0	1.0	4.1	0.30	5.40	1 : 5.0
6–12	500 "	12.0	1.3	6.8	0.30	8.40	1 : 6.0
12–18	700 "	16.8	1.4	9.1	0.28	10.78	1 : 7.0
18–24	850 "	20.4	1.4	10.3	0.26	11.96	1 : 8.0
	GROWING SHEEP.						
5–6	56 pounds	1.6	0.18	0.87	0.045	1.095	1 : 5.5
6–8	67 "	1.7	0.17	0.85	0.040	1.060	1 : 5.5
8–11	75 "	1.7	0.16	0.85	0.037	1.047	1 : 6.0
11–15	82 "	1.8	0.14	0.89	0.032	1.062	1 : 7.0
15–20	85 "	1.9	0.12	0.88	0.025	1.047	1 : 8.0
	GROWING PIGS.						
2–3	50 pounds	2.1	0.38	1.50		1.88	1 : 4.0
3–5	100 "	3.4	0.50	2.50		3.00	1 : 5.0
5–6	125 "	3.9	0.54	2.96		3.50	1 : 5.5
6–8	170 "	4.6	0.58	3.47		4.05	1 : 6.0
8–12	250 "	5.2	0.62	4.05		4.67	1 : 6.5

This Table expresses the average results of many carefully conducted experiments with cattle in which the quantity of the food used and the material produced by the animals, whether beef, milk or wool, were all accurately and repeatedly determined. The table involves no guess-work or speculation, but is to be regarded simply as a convenient and concise way of expressing the general results of the best practical experience in cattle feeding. Like all such general statements it must be used intelligently to be of any value. The special circumstances of the feeder, the ruling prices of the different articles of feed used, the individual peculiarities of his stock, all have to be considered and all may have a modifying effect on the composition or effect of the ration.

These tables and explanations are not substitutes for common sense or experience in feeding, but are helps to them.

A single example may here be given to illustrate the method of using the tables:

There are available for feeding a herd of milk cows, a rather short allowance of Timothy hay, plenty of wheat straw and turnips, while brewers' grains can be got fresh daily at a low price.

It is first to be determined about how much digestible matter these feeding stuffs contain. From the Table of Average Composition, their probable percentage amount of protein fat, etc., can be learned, and from the Table of Digestibility is found what proportion of the protein, fat, etc., is to be regarded as digestible. The calculation is as follows:—

	Pounds per hundred.		Per cent. digestible.		Pounds per hundred digestible.
TIMOTHY HAY.					
Organic matter[*]	84.83				
Protein	6.02	×	57[†]	=	3.43
Fat	2.20	×	48	=	1.05
N.-free Extract	46.26	×	62	=	28.68
Fiber	30.35	×	58	=	17.60
WHEAT STRAW.					
Organic matter	86.54				
Protein	4.98	×	17	=	.84
Fat	1.49	×	36	=	.53
N.-free Extract	41.99	×	39	=	16.37
Fiber	38.08	×	56	=	21.32
TURNIPS.					
Organic matter	10.40				
Protein	1.34	×	57	=	.77
Fat	.09[‡]				.09
N.-free Extract	8 11	×	89	=	7.22
Fiber	.86[‡]				.86
BREWERS' GRAINS.					
Organic matter	23.98				
Protein	5.57	×	73	=	4.06
Fat	1.68	×	84	=	1.41
N.-free Extract	12.86	×	64	=	8.23
Fiber	3.87	×	39	=	1.51

The Table of Feeding Standards gives as the average daily ration for milk cows—*per* 1000 *pounds live weight*:—

Total Organic matter	24.0	pounds
Digestible Protein	2.5	"
" N.-free Extract[§]	12.5	"
" Fat	0.4	"
Nutritive ratio	1 : 5.4	"

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[*] Dry matter less the ash.

[†] These are the digestion coefficients of medium meadow hay.

[‡] Regarded as wholly digestible.

[§] Including digestible fiber.

A few preliminary calculations may bring us to something like the following ration:—

	Organic matter, pounds.	Protein, pounds.	Fat, pounds.	N.-free Extract, pounds.	Fiber, pounds.
9 pounds hay, containing digestible.	7.6	.31	.09	2.58	1.58
10 " straw, " "	8.7	.08	.05	1.64	2.13
20 " turnips, " "	2.1	.15	.02	1.44	.17
20 " brewers' grains, "	4.8	.81	.28	1.64	.30
Total	23.2	1.35	.44	7.30	4.18

Comparing this ration with the Standard it has a little less organic matter, over one pound less protein and nitrogen-free extract (7.30 + 4.18 = 11.48), and the nutritive ratio is quite wide, viz. 1 : 9.3. Perhaps the ration under some circumstances might be economical. It needs the addition of some concentrated feed rich in albuminoids and N.-free extract, but poor in fat. Looking over the table of average composition of feeding stuffs, new process linseed meal seems to answer that description

Calculating the amount of digestible food in it as in the cases just given it appears that four pounds of it will bring the digestible protein of the ration up to the Standard.

	Organic matter.	Protein.	Fat.	N.-free Extract.	Fiber.
Already in the ration......	23.2	1.35	.44	7.30	4.18
4 pounds new process linseed meal............	3.6	1.08	.13	1.14	
Total....................	26.8	2.43	.57	8.44	4.18
				12.62	
Feeding Standard.........	24.0	2.50	.40	12.50	

In this ration we have 2.8 pounds more organic matter and ⅙ pounds more digestible fat than the Standard calls for, while digestible protein and nitrogen-free extract agree quite closely with the Standard. The nutritive ratio is 1 : 5.8.

It will be observed that the ration is calculated for 1000 *pounds live weight* and must be brought to correspond with the weight of the cows.

ANALYSES OF FEEDING STUFFS.

WHEAT FEED.

In a following table are given analyses of sixteen articles of this kind.

CLXXXVII was sent by B. F. Case, of Canton Center, from stock of Smith, Northam & Robinson, Hartford. It is a very coarse article and the price was somewhat lower in consequence. CXC, CXCL were sent by N. P. Perkins, Willimantic. CCV, CCVI, CCVII were from stock of E. A. Buck & Co., Willimantic. CC, from stock of A. Arnold & Co., and CCI, CCII, from stock of J. E. Bugby & Co., Willimantic, all sent by Mr. Perkins.

CLXXXVII, was sent by W. H. Childs, North Manchester. The other samples were kindly furnished by D. B. Crittenden & Co., of New Haven.

All prices with exception of that of CLXXXVII, were quoted in June, 1885.

The third column from the right in the table of analyses is "Percentage digestibility of protein." The actual digestibility of feeding stuffs is only to be determined positively by experiments with animals. It is sometimes quite desirable, however, as in the present case, to know the *comparative* digestibility of the most valuable food ingredient, namely the protein. A method has been devised to accomplish this with reasonable accuracy and far less outlay of time and labor than is involved in feeding trials.

This method consists essentially in heating at the temperature of the body, a weighed portion of the fodder, first with an artificial gastric juice prepared from hogs' stomachs, afterwards with a pancreatic solution prepared from the sweetbreads of cattle, and finally determining the amount of protein undissolved; the object being to imitate as closely as possible the digestive process of the animal. Some further notice of the details of the process will be found elsewhere in this report together with comparisons of the results obtained by this artificial digestion and by actual digestion.

The results in the table indicate that the average digestibility of the protein of bran is about five per cent. less than that of middlings or fine feed and that the last named articles are about equally digestible.

The last column but one of the table is "Comparative valuation per ton." It is very difficult if not impossible to give a just valuation to feed of different kinds; to compare for instance, cotton seed meal and turnips, meadow hay and oats, on a money basis. It is not so difficult to compare a number of kinds of feed of the same general character like those in this table. These are all

ANALYSES OF WHEAT FEED.

Station No.	Name.	Water.	Ash.	Protein.	Fiber.	Nitrogen free Extract.	Fat.	Water-Free. Ash.	Water-Free. Protein.	Water-Free. Fiber.	Water-Free. Nitrogen-free Extract.	Water-Free. Fat.	Percentage Digestibility of Protein.	Comp. valuation per ton.	Price per ton.
	Average of 30 samples of wheat bran	12.03	5.89	15.26	8.59	54.28	3.95	6.70	17.34	9.75	61.73	4.48	...	$18.00	
CLXXXVIII	Wheat bran	11.41	6.35	15.50	8.88	53.87	3.99	7.18	17.39	10.02	60.82	4.59	83.0	17.90	$17.00
CXCI	" "	13.20	6.15	15.56	9.83	50.96	4.30	7.08	17.93	11.33	58.71	4.95	85.1	18.03	18.00
	Average of 6 samples of spring wheat bran	11.32	5.86	15.33	8.80	54.35	4.34	6.59	17.29	9.92	61.32	4.88	...	18.25	
CXCVI	Wheat bran from spring wheat	13.57	5.72	14.93	8.94	52.47	4.37	6.71	17.25	10.33	60.67	5.04	81.2	17.39	
CCV	" " " " "	12.27	5.57	15.44	7.89	54.64	4.19	6.34	17.60	9.00	62.28	4.78	85.4	18.28	18.00
CCVI	" " " " "	12.31	5.98	15.12	10.12	52.08	4.39	6.81	17.24	11.54	59.41	5.00	81.8	17.59	18.00
CCVII	" " " " "	7.38	5.90	16.69	7.44	58.12	4.47	6.37	18.02	8.04	62.75	4.82	89.5	...	18.00
	Average of 6 samples of winter wheat bran	12.27	5.90	16.00	8.08	53.75	4.00	6.73	18.24	9.20	61.27	4.56	...	18.38	
CXCIV	Wheat bran from winter wheat	12.08	6.42	17.75	8.75	50.54	4.46	7.29	20.19	9.92	57.54	5.06	85.6	19.41	
CXCVIII	" " " " "	13.35	6.01	16.50	8.93	51.15	4.06	6.92	19.03	10.28	59.09	4.68	85.2	18.50	
	Average of 10 samples of Middlings	11.50	3.44	16.60	3.86	60.28	4.32	3.88	18.76	4.35	68.14	4.87	...	20.05	
CLXXXVII	Middlings	10.23	3.58	19.18	3.28	59.16	4.57	3.98	21.35	3.65	65.94	5.08	...	...	
CXCVII	" from spring wheat	13.00	4.09	17.94	7.04	53.02	4.91	4.70	20.61	8.08	60.97	5.64	88.8	20.39	
CXCV	" " " "	12.73	3.75	17.63	4.31	57.38	4.20	4.28	20.21	4.93	65.77	4.81	89.7	20.32	
CXCIX	" " " "	13.68	2.13	18.19	1.90	60.95	3.15	2.46	21.08	2.20	70.62	3.64	90.7	20.58	
	Average of 4 samples of fine feed	12.46	3.80	15.88	4.72	59.07	4.07	4.34	18.14	5.39	67.48	4.65	...	19.37	
CXC	Fine feed	11.98	4.05	16.06	5.14	58.39	4.38	4.59	18.24	5.83	66.36	4.98	88.7	19.42	20.00
CC	" "	12.17	4.50	16.20	5.63	57.17	4.33	5.12	18.44	6.40	65.12	4.92	89.6	19.12	20.00
CCI	" "	12.89	4.16	15.44	5.75	57.55	4.21	4.78	17.72	6.59	66.08	4.83	89.1	18.71	22.00
CCII	" "	12.82	2.50	15.81	2.35	63.15	3.37	2.87	18.10	2.68	72.49	3.86	93.3	19.70	24.00

derived from the same source and do not differ greatly in digestibility or in their specific action on the animal. The method of calculation is as follows: Experiments with cattle have shown that in case of wheat bran about 33 per cent. of the fiber, 77 per cent. of the nitrogen-free extract and 69 per cent. of the fat are digestible. Taking the relative digestibility of the protein as a basis we may easily calculate the amounts of *digestible* protein, fiber, nitrogen-free extract and fat which each sample contains and thus acquire with tolerable certainty the proper data for comparison. It has been found in a large number of trials that if in concentrated food a pound of digestible protein and fat is valued at 4½ cents, and a pound of digestible fiber and nitrogen-free extract at nine-tenths of a cent the valuation will agree fairly well with the market price. In our experience the valuation thus obtained is slightly higher than the market price. The valuation has been made in this way for each of these samples and also for "average of 30 samples of wheat bran." Each of these valuations amounts to $20.00 per ton or over. But the average price of bran is now about $18.00. Therefore the valuation of average bran is reduced to $18,00 and all others are reduced proportionally; the result being a comparison of the feeding value of the brans, middlings and fine feeds with bran of average quality;— in term of dollars and cents.

This comparison shows that when bran is worth $18.00 per ton, the average feeding value of middlings is about $20.00 and of fine feed about $19.37. To make the comparison of these articles more conplete their manurial value should likewise be considered.

In the following table are given complete analyses made at this Station of the ash of wheat bran (sample CXCVIII) and of middlings (CXCV) and for comparison a single analysis of ash of wheat flour, the average of four analyses of the ash of whole wheat made at the U. S. Department of Agriculture and the average composition of the ash of European wheat as given by Wolff.

The figures show that the larger part of the mineral matter of the wheat kernel is in the exterior portions which form the bran: thus the ash constitutes only about 2 per cent. of the whole wheat, while 3¾ per cent. of middlings and 6 per cent of bran consists of ash or mineral matter. The ash of bran and middlings is considerably richer in phosphoric acid and poorer in potash and lime than that of the whole wheat.

ASH ANALYSES.

	Bran.	Middlings.	Flour.	Whole wheat.	Winter wheat.	Spring wheat.
	CXCVIII.	CXCV.	U. S. Dept. of Ag.		Wolff's averages.	
Per cent. of ash	6.01*	3.75†	.41	1.70	1.97	2.14
Composition of ash:						
Potash	26.60	26.53	31.54	29.08	31.16	29.99
Soda	3.49	1.75	2.93	1.31	2.25	1.93
Lime	.15	.92	5.87	3.51	3.34	2.93
Magnesia	9.55	11.79	9.05	15.06	11.97	12.09
Oxide of Iron	trace	trace	....	trace	1.31	.51
Manganese	....	....	....	.07	....	....
Sulphuric acid	1.20	.26	....	.28	.37	1.52
Phosphoric acid	53.62	54.22	49.63	47.76	46.98	48.63
Chlorine	....	....	....	.48	.22	.48
Silica and sand	.45	1.37	.98	2.45	2.11	1.64
Water and charcoal	3.83	2.46	....	....	....	....
Other matters by difference	1.11	.70	....	....	.29	.28
	100.00	100.00	100.00	100.00	100.00	100.00

With the aid of the analyses just given the manurial matter in a ton of bran and middlings may be calculated with tolerable accuracy and is as follows:—

In one ton of are contained pounds of	Bran.	Middlings.
Nitrogen	*48.8*	*.53*
Phosphoric acid	*63.3*	*38.0*
Potash	*31.4*	*18.6*
Soda	4.1	1.2
Lime	.2	.6
Magnesia	11.3	8.0
Sulphuric acid	1.4	.2
Silica and sand	.5	1.0

It is worth noticing that these kinds of wheat feed contain only about a quarter of one per cent. less nitrogen than average ammoniated superphosphates, and that the average car load (12 tons) of bran brought into the State brings with it in round numbers 570 pounds of nitrogen, 760 pounds of phosphoric acid and 370 pounds of potash.

It is impossible to assign a correct money value to the fertilizing ingredients contained in stable or yard manure because they are so largely diluted with water [75 to 80 per cent.] and other materials which increase enormously the cost of handling and transporting them. The actual value may be expressed however in this way:—a ton of bran fed to cattle that are neither laying on flesh or giving milk will add to the manure about as much available nitrogen, phosphoric acid and potash as are contained in

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* The average of 30 analyses gave 5.90 per cent. of ash.

† The average of 10 analyses gave 3.40 per cent. of ash.

500 pounds of fish.
100 " " ground bone and
60 " " muriate of potash.

Of course if milk and beef are being produced, certain quantities of the ash elements of the bran as well as of its nitrogen go with them and are more profitably utilized in those forms than in manure.

ALBUMINOID AND NON-ALBUMINOID NITROGEN IN WHEAT BRAN.

It is the universal practice to determine protein in feeding stuffs by multiplying the percentage amount of nitrogen which they contain, by the factor 6¼. This method rests on two assumptions: 1st, That all the nitrogen present is combined in true albuminoid bodies, and 2d, That all albuminoids contain 16 per cent. of nitrogen (16 per cent. × 6¼ = 100 per cent.). As already stated, the second assumption is not fully justified by facts. Some of the vegetable albuminoids contain little more than 15 per cent. others nearly 18 per cent., so that the true factor in any case lies somewhere between 5½ and 6⅔. Generally however the factor 6¼ introduces only a small error. The other assumption is more widely at variance with what is at present known. Besides albuminoids there are in almost all feeding stuffs, other nitrogenous matters; either nitrates, ammonia salts, alkaloids, amido-acids or amides, or several of them together. In some, these are found only in very small amount, in others, notably in root-crops, beets, turnips, potatoes, etc., and in plants which are harvested while in rapid growth, fodder corn, hay, etc., a large part of the nitrogen, in some cases from a third to a half of it is in other forms than albuminoids, chiefly as amides or amido-acids. At present it is not advisable to change the method of expressing the nitrogen content of feeding stuffs, but it is very desirable that every analysis made should include a determination of non-albuminoid nitrogen, and if this is large, a determination also of the nitrogen present as amides or amido-acids.

The albuminoid nitrogen has been determined in three samples each of bran and middlings whose analyses have just been given.

The results are as follows:

ALBUMINOID AND NON-ALBUMINOID NITROGEN OF WHEAT FEED.

No.	Name.	Per cent. of Nitrogen present.			Albuminoid nitrogen in per cent. of total nitrogen.
		Total.	Albuminoid.	Non-Albuminoid.	
CXCIV.	Bran	2.84	2.54–	.30–	89.4
CXCVI.	Bran	2.39	2.00–2.04	.39–.35	84.5
CXCVIII.	Bran	2.64	2.18–2.18	.46–.46	82.6
CXCV.	Middlings	2.82	2.63–2.54	.19–.28	91.8
CXCVII.	Middlings	2.87	2.59–2.50	.28–.37	88.9
CXCIX.	Middlings	2.91	2.59–2.54	.32–.37	88.3

The average is 87.6 per cent. albuminoid nitrogen.

The method here employed is Stutzer's perfected method given in the Journal für Landwirthschaft, 1881, page 476, and is briefly as follows:

Heat 1 gram of the material with 100 c. c. absolute alcohol and 1 c. c. acetic acid to boiling on the water bath. Decant the clear solution through a small filter, using care to avoid bringing any more of the residue than can be helped with it, and wash the filter, to remove fat, with a little warm alcohol. Add to the contents of the beaker 100 c. c. of water and boil,—or if the substance has much starch, heat for 10 minutes on the water bath,—add 0.3–0.4 gram of $Cu(OH)_2$ suspended in water,* after cooling bring on the filter which has been already used, wash with a little water, twice with alcohol, to facilitate drying, dry at 100° C. and determine albuminoid nitrogen by combustion with soda-lime, or (more conveniently in our experience) by Kjeldahl's method.

CORN MEAL.

CCIV. Stock of Ansel Arnold & Co. Cost $23.60 per ton.

CLXXXIX. Cost $23.20 per ton.

CXCIII. High mixed corn, ground by E. A. Buck & Co., Willimantic. Cost $23.20 per ton.

CCIII. Ground at Swanton, Vt., for J. C. Bugby & Co. Cost $23.60 per ton.

The above were sampled from stock of Willimantic dealers and sent by N. P. Perkins. The prices were quoted in June.

ANALYSES OF CORN MEAL.

	Average of 34 Analyses.	CCIV.	CLXXXIX.	CXCIII.	CCIII.
Water	15.03	12.04	13.12	13.29	14.24
Ash	1.45	1.38	1.42	1.43	1.55
Protein	9.09	10.19	10.00	9.81	9.50
Fiber	1.85	1.88	1.75	2.71	1.28
N.-free Extract	68.86	70.14	69.21	68.20	70.80
Fat	3.72	4.37	4.50	4.56	2.63
	100.00	100.00	100.00	100.00	100.00

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* Fassbender's preparation, Landw. Versuchs-St. XXVII, 125.

ANALYSES OF CORN MEAL.

	Average of 34 Analyses.	CCIV.	CLXXXIX.	CXCIII.	CCIII.
Ash	1.71	1.57	1.63	1.65	1.80
Protein	10.70	11.58	11.51	11.32	11.06
Fiber	2.18	2.13	2.00	3.12	1.52
N.-free Extract	81.04	79.75	79.68	78.66	82.56
Fat	4.37	4.97	5.18	5.25	3.06
	100.00	100.00	100.00	100.00	100.00
Percentage digestibility of Protein	84.0	82.8	80.6	86.0	85.5
Comparative valuation*	$24.00	$25.46	$25.12	$25.48	$23.84

The comparative feeding values of these samples are calculated in the same way as those of wheat feed described on page 37, the relative digestibility of the protein being determined as before by artificial digestion and the average digestion coefficients of the remaining nutrients of maize being taken from the table, page 26 as follows:

Fat	85	per cent.
Fiber	62	"
N.-free extract	91	"

These calculated values are based on the assumption that all the meals are equally relished by cattle and that they differ in feeding value only because of differences in composition and digestibility.

As regards their chemical composition all the samples are above the average of corn meal excepting CCIII, which has four tenths per cent. more protein but more than a per cent. less fat than average corn meal.

HOMINY MEAL.

CXCII. From Stock of Ansel Arnold & Co., Willimantic. Cost $22.00 per ton in June. Sent by N. P. Perkins, Willimantic.

ANALYSIS.

		Water free.
Water	9.22	
Ash	3.12	3.44
Protein	11.20	12.34
Fiber	4.02	4.43
N.-free Extract	62.88	69.26
Fat	9.56	10.53
	100.00	100.00

This by-product of the hominy manufacture consists largely of the hull and the chit or germ of maize. It has considerably more protein than maize meal and more than two and a half times as much fat. The presence of so much fat makes the material more liable than maize meal to become rancid and unpalatable. Mr. Perkins has used it in past years in place of maize meal for milk cows. The daily ration per cow was 4 quarts of hominy meal, 2 quarts wheat bran and 2 quarts "fine feed," well mixed and fed wet. He states that the cows kept in excellent condition and gave more milk than on yellow corn meal. In Mr. Perkins' experience it cannot be fed to fatting cattle quite so freely as maize meal.

RYE BRAN.

CCX. New York State Rye Bran, Stock of D. B. Crittenden & Co., New Haven. Sampled by the seller.

	ANALYSIS.	Water-free.
Water	12.31	
Ash	4.35	4.91
Protein	16.06	18.30
Fiber	4.09	4.66
N.-free Extract	60.15	68.67
Fat	3.04	3.46
	100.00	100.00

NEW PROCESS LINSEED MEAL.

CCIX. From lot purchased by T. S. Gold, West Cornwall.

		Water-free.
Water	12.70	
Ash	5.14	5.88
Protein	33.25	38.09
Fiber	8.08	9.36
N.-free Extract	37.19	42.51
Fat	3.64	4.16
	100.00	100.00

GLUTEN FEED.

CCVIII. Sold by Holmes and Keeler, Norwalk. Cost $25.00 per ton. Sampled and sent by D. H. Van Hoosear, Wilton.

	ANALYSIS.	Water-free.
Water	8.86	
Ash	1.01	1.10
Protein	29.12	31.93
Fiber	.86	.94
N.-free Extract	53.91	59.20
Fat	6.24	6.83
	100.00	100.00

On the Artificial Digestion of Feeding Stuffs.

Stutzer, Journal für Landwirthschaft, 1880, 195, has applied the method of artificial digestion, which had often been used previously in experiments with animal albuminoids to the quantitative examination of the protein of feeding stuffs.

His object was to determine whether by long continued digestion with an acid pepsin solution at the temperature of the body all of the protein of cattle food could be dissolved; and if not, whether by such experiments any valuable conclusions could be drawn in reference to the actual digestibility of such food by cattle. His experiments were confined to a limited number of feeding stuffs but were made under a variety of conditions to determine what was the most efficient pepsin solution, the best proportion of the solution to the material examined, acidity of solution, time of digestion, etc. In following papers (same Journal 1880, 435, and 1881, 478) he also studied the effect of an alkaline pancreatic solution, by itself and also following the pepsin digestion. On the kinds of feed which he examined pancreas solution had no more effect in any case than pepsin solution and all his experiments led him to conclude:

1. That the so-called protein of fodders consists of two parts which are chemically and physiologically distinct, viz: "Albuminoids" which are freely soluble in pepsin or pancreas solution, and a substance insoluble in these reagents which he termed "nuclein."

2. That the digestibility of a fodder is directly conditioned on its chemical composition. Artificial digestion will accurately show the amount of "nuclein" and "albuminoids" present in it. The use of feeding experiments is to discover under what conditions the "albuminoids" can most perfectly be digested by the animal while nuclein (he leaves the reader to infer) is valueless as food.

Pfeiffer (same Journal, 1883, 221) makes an elaborate comparison of the results obtained by Stutzer's methods with the results of digestion experiments on sheep, and an examination of the so-called "nuclein."

His conclusions are, that Stutzer's "nuclein" is digested by sheep to the extent of 20–30 per cent.; that the portion of protein which is insoluble in Stutzer's reagent is not a nuclein and hence the name should be dropped; that Stutzer has given us a valuable means of comparing the digestibility of feeds (as regards their protein), but care is necessary not to make too wide generalizations.

Pfeiffer gives results of 17 comparisons of the digestibility of protein by artificial digestion with the digestibility of protein in the same fodders determined by experiments on sheep.

They are as follows:—

Feed.	No. of Experiments.	Per cent. of the total protein which was digested:— By sheep.	By pepsin solution.
Meadow hay	1	60.4	68.4
Lucerne hay	2	73.8	76.0
Hay and barley	4	55.9	63.9
Hay, barley and conglutin	6	78.3	82.4
Hay, barley and fleshmeal	4	75.6	78.3

Stutzer in a subsequent paper (Zeitschrift für Physiolog. Chem. 1885, 211) drops the name "nuclein."

After learning of Pfeiffer's results he reviews his own, enlarges the number of materials experimented on and finds that in many of them a portion of the protein insoluble by pepsin is soluble by a pancreas solution to the extent of some 20 to 30 per cent. of this portion—the same extent in fact to which Pfeiffer had found it digestible by sheep. He therefore advises a digestion with pancreas solution following one with pepsin solution in all cases.

It is seen from the results given that the digestibility of protein by Stutzer's method is considerably higher than by direct experiments with animals. The experiments of Kellner (Centralblatt Ag. Chem. ix, 1880, 763, Landw. Versuchs-St., 1879, 434) and others make it evident that the results of feeding experiments involve an error which tends to make the results as to protein in some cases, at least, too low. The extent of this error is not yet fully determined and hence it is not possible yet to decide how closely the perfected methods will agree. The most important use of the method of artificial digestion at present is in the comparison of different samples of the same kind of feed, like the wheat bran and middlings already discussed. Here follows a description of Stutzer's mode of preparing and using the digestive solutions.

PEPSIN SOLUTION.

The inner membrane of a hog's stomach is cut into small pieces with shears and put in a flask with 5 liters of water 25 grams of salicylic acid and 75 c. c. of a ten per cent. hydrochloric acid.

Let the mixture stand 2–3 days with frequent shaking; strain, without pressure, through flannel and filter through paper. This solution will keep for months.

PANCREAS SOLUTION.

Free the sweet breads of neat cattle as much as possible from fat, let them lie 24 hours in the air, pulverize finely with sand, and to 400 grams fresh pancreas add 1 liter of glycerin and 1 liter of water. Shake frequently and after 4–6 days strain and filter.

THE DIGESTION.

To 2 grams of the material, ground to pass a 1m.m. sieve, are added 250 c. c. of the pepsin solution in a beaker which is covered with a watch glass and placed in a water bath kept at 40° C. After 1 to 2 hours, 0.1 per cent. of hydrochloric acid is added and at regular intervals the same quantity is again added till at the end of 12 hours the solution contains in all 0.5 per cent. of hydrochloric acid. The lamp is removed and the beaker cooled gradually. The next day the digestion is continued as before for 12 hours and the amount of acid present is gradually brought to 1 per cent. The solution is then filtered and washed. To the residue are added 250 c. c. pancreas solution and one-half per cent. of sodium carbonate and the digestion at 40° C. is continued for 24 hours, when the residue is filtered, washed and dried and its nitrogen is determined in the usual way.

In the work done at this Station we have made certain modifications in the preparation of the solutions, suggested by Dr. R. H. Chittenden of the Sheffield Scientific School.

The pepsin solution is prepared by dissolving 5 grams of scale pepsin in 1 liter of 0.2 per cent. hydrochloric acid and filtering the solution.

The sweet breads from cows or steers are passed through a sausage cutter and put into a large quantity of alcohol where they remain for a week or more. The alcohol is strained off and the residue extracted with ether, thoroughly dried, ground and bottled. In this shape it will keep indefinitely. To prepare the solution, 20 grams of the dry pancreas, together with 2.5 grams of salicylic acid and 250 c. c. of water are heated at 40° C. for 12 hours. The solution is then filtered and the residue washed till filtrate and washings amount to 1 liter.

Of this solution 200 c. c. are used in each experiment, with 0.6 gram sodium carbonate and a few drops of a solution of 20 grams thymol in 100 c. c. of alcohol.

THE CONNECTICUT FERTILIZER LAW

The General Assembly at its session in 1882 passed a new Fertilizer Law, which went into effect September 1, 1882, and which repeals and takes the place of all previous legislation on this subject in this State.

Since a full understanding of the provisions and penalties of this law is important to all parties who buy or sell commercial fertilizers, attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a *certified statement* of composition. net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a *sealed sample* shall be deposited with him by the MANUFACTURER OR IMPORTER. Section 2.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

4. All "CHEMICALS" that are applied to land, such as : Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Lime (Gypsum or Land Plaster), Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 9 of the Act.

Here follows the full text of the law, with explanatory footnotes.

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

GENERAL ASSEMBLY,
January Session, A. D. 1882.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

Printed statement to be affixed to all packages and to go with all lots.

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

SEC. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said

Before sale *certified copies* of statement, and *Sealed Sample* to be deposited with Director.

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* A statement of the per cents. of Nitrogen, Phosphoric Acid (P_2O_5) and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given separately or together. and the term "available" may be used in addition to, but not instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric Acid.

For Potash Salts give always the per cent. of Potash (potassium oxide); that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

Analysis Fee to be paid annually on or before May 1st.

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

Yearly Report to Station of Dealers or Agents.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

Leather.

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

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* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

On receipt of statements, samples and analysis-fees, the Station will issue Certificates of Compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

SEC. 6. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture. Fish-guano, &c.

SEC. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation. Fines.

SEC. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State. Fertilizers for private use.

SEC. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the station, and shall cause one or more analysis of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer. Director's duties and authority.

SEC. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State. Bulletins.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed. Repeal of former acts.

SEC. 12. This act shall take effect on the first day of September, 1882.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in section 9, that all fertilizers be analyzed and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

OBSERVANCE OF THE FERTILIZER LAW.

Manufacturers who have paid Analysis Fees as required by the Fertilizer Law, and Fertilizers for which the Fees have been thus paid for the year ending May, 1886.

Firm.	*Brand of Fertilizer.*
Adams & Thomas, Springfield, Mass.	Adams Market Bone Fertilizer.
	" Fine Ground Bone.
Anderson, W. H., Putnam, Ct.	Ground Bone.
Baker, H. J. & Bro., 215 Pearl St., New York.	A.A. Ammoniated Superphosphate.
	Pelican Bone Fertilizer.
	Potato Fertilizer.
	Corn "
	Tobacco "
	Castor Pomace.
	Kainit.
	Muriate of Potash.
Bennett, P. W., Rock Fall, Conn.	Ground Bone.
Bosworth Bros., Putnam, Conn.	Superphosphate of Lime.
	Ground Bone.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Grain Manure.
	" Forage Crop Manure.
	" Vegetable "
	Bowker's Hill and Drill Phosphate.
	" Dissolved Bone.
	" Fish and Potash.
	" Dry Fish.
	" Kainit.
Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Bradley's Superphosphate.
	B. D. Sea Fowl Guano.
	Original Coe's Superphosphate.
	Complete Manure for Corn and Grain.
	" " Potatoes and Root Crops.
	Circle Brand Bone and Potash.
Buffalo Fertilizer & Chemical Works, Buffalo, New York.	Buffalo Ammoniated Bone Superphosphate.
	Buffalo Potato, Hop and Tobacco Phosphate.
	Buffalo Superphosphate [2].
	Queen City Phosphate.
	Pure Ground Bone.
Chemical Ammoniate & Oil Co., N. Y., per Geo. A. Niles, Danielsonville, Ct.	Niles' Special Fertilizer.
Clark's Cove Guano Co., New Bedford, Mass.	Great Planet " A " Brand.
	Bay State Fertilizer.
	Unicorn Ammoniated Superphosphate.
Coe, E. Frank, 16 Burling Slip, New York.	Ammoniated Bone Superphosphate.
	Alkaline Bone.
	Excelsior Guano.
	Ground Bone.
	Ralston's Potato Phosphate.
Collier White Lead & Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford, Ct.	Castor Pomace.
Common Sense Fertilizer Co., Boston, Mass.	Common Sense Fertilizer, No. 2.
	" " " [D].
Peter Cooper's Glue Factory, New York.	Bone Dust.

Firm.	*Brand of Fertilizer.*
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Darling's Ground Bone.
	" Animal Fertilizer.
Dickinson, D. B., Middle Haddam, Ct.	Ammoniated Bone Superphosphate.
Glidden & Curtis, Boston, Mass.	Soluble Pacific Guano.
Hall, W. Burr, Wallingford, Ct.	Ground Bone.
Harris, G. H. & Son, Eagleville, Ct.	Pure Ground Bone.
	Pure Bone Phosphate.
Hurtado & Co., 16 and 18 Exchange Place, New York City.	Peruvian Guano Standard.
Judson & Sparrow, 38 South Market St., Boston, Mass.	Sparrow's Bone and Potash Phosphate.
	" B. B. Phosphate.
Lister Bros., Newark, N. J.	Ground Bone.
	Crescent Bone.
	Standard Superphosphate.
	Ammoniated Dissolved Bone.
	Potato Fertilizer.
	U. S. Phosphate.
Lombard & Matthewson, Warrenville, Ct.	Ground Bone.
	Superphosphate.
Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Mapes' Potato Manure.
	" Corn "
	" Complete Manure (Light Soil).
	" " " (General use).
	" Tobacco " (Conn. Brand).
	" " "(for use with stems)
	" Complete " (A Brand).
	" Nitrogenized Superphosphate.
	" High Grade Superphosphate.
	" Fine Dissolved Bone.
	" Muriate of Potash.
	" Nitrate of Soda.
	" Sulphate of Ammonia.
Meyer, C., Jr., Maspeth, L. I.	Acme Fertilizer, No. 1.
	" " No. 2.
Miles, George W., Milford, Ct.	I. X. L. Ammoniated Superphosphate Fish and Potash.
Miller, G. W., Middlefield, Ct.	Raw Bone Phosphate.
	Pure Ground Bone.
Mitchell, A., Linden, N. J.	Standard Phosphate.
National Fertilizer Co., Bridgeport, Ct.	Chittenden's Fish and Potash.
	" Ammoniated Bone Superphosphate.
	Chittenden's Complete Fertilizer.
	Cooke's Blood Guano.
New Haven Fertilizer Co.	Standard Superphosphate.
Niles, G. A. (See Chemical Ammoniate & Oil Co.)	
Peck Brothers, Northfield, Ct.	Peck Brothers' Pure Ground Bone.
Pinney, R. E., Suffield, Ct.	"Potash and Phosphoric Acid."
Plumb & Winton, Bridgeport, Ct.	Bone Fertilizer.
	Ground Bone.
Preston Fertilizer Co., Greenpoint, L. I.	Preston's Ammoniated Superphosphate
	" Ground Bone.
	" Fish Guano.
Quinnipiac Fertilizer Co., New London, Ct.	Nitrate of Soda.
	Fish and Potash, Plain Brand.
	" " Crossed Brand.
	Phosphate.
	Extra Phosphate.
	Dry Ground Fish.
Ralston, J. (See E. Frank Coe).	

Firm.	*Brand of Fertilizer.*
Read & Co., 88 Wall St., New York.	Farmers' Friend Fertilizer.
Rogers & Hubbard Co., Middletown, Ct.	Pure Raw Knuckle Bone A.
	Pure Raw Knuckle Bone Meal.
	Ground Bone AX.
	Bone Sawdust.
Russell Coe Fertilizer Co., 88 Wall St., New York.	Davidge's A.A. Ammoniated Bone Superphosphate.
	Davidge's Potato Manure.
	" Soluble Bone Phosphate.
Sanford, Chas., Redding Ridge, Ct.	Ammoniated Superphosphate
Shoemaker, M. L. & Co, Philadelphia, by F. Ellsworth, Hartford, Ct.	Good-enough Phosphate.
	Echo Phosphate.
	Swift Sure Superphosphate.
	" " Bone Meal.
	Kainit.
Slade, F. C., Oakville, Ct.	Ground Bone.
Sisson & Strong, North Lyme, Ct.	Elizabethport Glue Works Ammoniated Superphosphate.
Smith, Edmund, South Canterbury, Ct.	Ground Bone.
St. Louis Lead & Oil Co., St. Louis, Mo.	Castor Pomace.
Stearns & Co., 149 Front St., New York.	Stearns' Ammoniated Bone Superphosphate.
	Eagle Brand Fish and Potash.
	Ground Fish Guano.
Thomson, Paul, 232 State St., Hartford.	Charter Oak Fertilizer.
Tropic Guano Co., Elizabethport, N. J.	XXX Guano.
Wilcox, L. & Co., Mystic Bridge, Ct.	Wilcox's Prepared Fertilizer.
	" Acidulated Fish Guano.
	" Dry Ground Fish.
Wilkinson & Co., 239 Center St., New York.	Wilkinson's Ammoniated Superphosphate.
Williams, Clark & Co., 101 Pearl St., New York.	Americus Ammoniated Superphosphate.
	" Potato Fertilizer.
	" Bone Meal.
	Royal Bone.
	Acorn Brand Muriate of Potash.
	" " German Potash Salts.
	Fish and Potash.
	Dry Ground Fish.
	Bone and Potash.
	Dried Blood.
	Americus Tobacco Fertilizer.

ANALYSES OF FERTILIZERS.*

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that will work against the public good.

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* The matter of this and several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied, with a few appropriate alterations, from the Report for 1885. This repetition appears to be necessary for the use of readers who have not seen former Reports.

During 1885, two hundred and fifty-six (256) samples of fertilizers have been analyzed. Of these, 23 were examined for private parties, and the remainder for the general use of the citizens of the State.

Seventy-three samples analyzed for the public benefit have been sent in by purchasers and consumers. The rest have been supplied by agents of the Station who during the spring and early summer endeavored to visit all sections of the State, to take one or more samples from every brand of fertilizer offered for sale in the State, and to take them from the stock of dealers in remote places as well as from centers of trade.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one, by means of a sampling tube, which withdraws a section or core through the entire length of the package.

The greatest care is necessary in sampling fertilizers that the small sample taken shall accurately represent the whole stock from which it is drawn. Otherwise serious injustice may be done.

During the year the Station has had to reject a number of samples sent in for analysis by purchasers on account of evident carelessness in drawing them.

The Station none the less desires the coöperation of farmers and Farmers' clubs in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All such samples are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION.

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

The *valuation* of a high-priced Fertilizer requires the amounts *per cent.* of its principal fertilizing elements to be known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit-can or tin box, holding about *one quart*, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

THE CONN. AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

The foregoing instructions may be over-nice in some cases, but they are not intended to take the place of good sense on the part of those who are interested in learning the true composition of a fertilizer. Any method of operating that will yield a *fair sample* is good enough.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin-tube, like a dipper handle, put well down into the packages, in a good number of places, will give a fair sample with great ease. With dry, coarse articles, such as ground bone, there is liable to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling. Otherwise the analysis will certainly misrepresent the article whose value it is intended to fix.

The quantity sent should not be too small. When the material is fine and uniform, and has been carefully sampled, a pint may be enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the sample should not be *less than one quart.*

It is also important that samples for analysis should be taken at the time when the fertilizer is purchased, and immediately dispatched to the Station. Moist fish, blood or cotton seed meal will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

These changes in the composition of a sample not suitably preserved must invalidate any conclusions from its analysis, and work serious injustice either to the manufacturer or to the consumer.

It doubtless often happens that a purchaser on laying in a stock of fertilizers decides that he will not then trouble the Station to analyze the goods he has obtained, but will set aside samples which he can send for examination in case the crops report adversely as to their quality. It is always better to send all samples at once to the Station, where they can be directly analyzed or so prepared that they will keep without chemical change.

With the Instructions for Sampling, the Station furnishes a blank form for Description of Sample, a copy of which is here given.

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

FORM FOR DESCRIPTION OF SAMPLE.

Station No........... Rec'd at Station,................. 18

Each sample of Fertilizer sent for gratuitous analysis must be accompanied by one of these Forms, with the blanks *below* filled out fully and legibly.

The filled out Form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

Brand of Fertilizer,..

Name and address of Manufacturer,........................

....

Name and address of Dealer from whose stock this sample is taken, ...

Date of taking this sample,..................................

Selling price per ton or hundred, bag or barrel,..............

Selling weight claimed for each package weighed,............

Actual weight of packages opened,..........................

Here write a copy of any analysis or guaranteed composition that is fixed to the packages.

....

Signature and P. O. address of person taking and sending the sample.

....

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description" which accompanies it is filed in the Station's Record of Analyses, and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least, under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description," when properly filled out, also, contains all the data of cost, weight, etc., of a fertilizer which are necessary for making, with help of the analysis, a valuation of its fertilizing elements, and estimating the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the description may work injustice to the manufacturers or dealers, as well as mislead consumers. It is especially important that the *brand* of a fertilizer and its *selling price* shall be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated, and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for explanation or protest, if desirable, before the results are published in the Bulletin.

With the analysis there is sent to the party furnishing the sample a printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages, and are, therefore, reproduced here, as follows:

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

REVISED.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *Phosphoric acid* means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and reverted phosphoric acid are on the whole about equally valuable as plant-food and of nearly equal commercial value. In some cases, indeed, the soluble gives better results on crops, in others the reverted is superior. In most instances there is probably little to choose between them.

Insoluble Phosphoric acid implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada Apatite. Bone black, bone-ash, South Carolina Rock and Navassa Phosphate when in coarse powder are commonly of little repute as fertilizers though good results are occasionally reported from their use. When *very finely pulverized* ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones, which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It should be soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this Station, signifies finding *the worth in money or trade-value, of its fertilizing ingredients.* This value, it should be remembered, is *not necessarily proportional to its fertilizing effects* in any special case.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $60 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade Value of the above-named Ingredients*, a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

The average Trade-values or retail cost in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the New England, New York and New Jersey markets, are as follows :—

These Trade-values were agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several States during 1885.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1885.

	Cents per lb.
Nitrogen in ammonia salts	18
" in nitrates	18
Organic nitrogen in dried and fine ground fish	18
" " in guanos, dried and fine ground blood and meat	18
" " in cotton seed, linseed meal and in castor pomace	18
" " in fine ground bone	18
" " in fine medium bone	16
" " in medium bone	14
" " in coarse medium bone	12
" " in coarse bone, horn shavings, hair and fish scrap	10
Phosphoric acid, soluble in water	9
" " soluble in ammonium citrate*	8
" " insoluble, in dry fine ground fish and in fine bone,	6
" " " in fine medium bone	5½
" " " in medium bone	5
" " " in coarse medium bone	4½
" " in coarse bone	4
" " " in fine ground rock phosphate	2
Potash as high grade sulphate	7½
" kainit	4½
" muriate	4½

The above trade-values are the figures at which on March 1st the respective ingredients could be bought at retail for cash, in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the *reasonable retail price* in case of standard raw materials such as:—

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* Dissolved from 2 grams of the unground phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Plain Superphosphate.

Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bone,
Ground So. Car. Rock.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES AND MIXED FERTILIZERS OF HIGH GRADES.

The Organic Nitrogen in these classes of goods is reckoned at the highest figure laid down in the Trade-Values of Fertilizing Ingredients in Raw Materials, namely 18 cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, blood, animal matter, Peruvian guano or other equally good forms and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric acid is reckoned at 4 cents, it being assumed that it is from bone or similar source and not from rock phosphate, unless found otherwise. In this latter form the insoluble phosphoric acid is worth commercially only 2 cents per pound or but one-half as much as if from fine bone. Potash is rated at 4½ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash is reckoned as sulphate.

In most cases the valuation of the Ingredients in Superphosphates and Specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally, profits.

In 1885 the average selling price of Ammoniated Superphosphates and Guanos was $37.60, the average valuation was $30.47, and the difference $7.13—an advance of 23.4 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of Specials the average cost was $44.80, the average valuation $38.70, and the difference $6.10 or less than 16.0 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 1st, 1884, to November 1st, 1885, were as follows :

Phosphate Rock,	1
Phosphatic Guano,	1
Precipitated Phosphate of Lime,	1
Superphosphates (plain),	16
Superphosphates [ammoniated] and Guanos,	100
Superphosphates and other fertilizers, home-made,	13
Special Manures,	27
Bone Manures,	34
Ammonite,	3
Dry Ground Fish,	10
Dried Blood,	2
Blood and Tankage,	1

Peat and Offal,	3
Buffalo Horn Dust,	1
Nitrates,	2
Sulphate of Ammonia,	4
Cotton Seed,	1
Potash Salts,	11
Cotton Hull Ashes,	9
Tobacco Stems,	1
Tobacco Stems and Bone,	1
Tobacco Dust,	1
Wool Waste,	1
Gas House Refuse,	1
Chloride of Lime,	1
Shell Lime,	1
Marine Mud,	2
Decomposed Rock Weed,	1
"Sea Lettuce,"	1
Swamp muck or Peat,	2
Cave Guano,	1
Ground Horn and Hoof,	1
Leather Extracted by Benzine,	1
	256

Of these 23 were samples analyzed for private parties and are not further noticed in these pages.

The remaining analyses are given in detail so far as they have any general interest, with such discussion as may make them more serviceable:

PHOSPHATIC GUANO.

1578. Bolivian Guano. Imported by the Quinnipiac Fertilizer Co., New London. Sampled by J. P. Little, Columbia, from his own stock. Guaranteed 16 per cent. Phosphoric acid. Cost $30.00 per ton.

ANALYSIS.

Phosphoric Acid, soluble in ammonium citrate*	5.37
Phosphoric Acid, insoluble " "	11.87

The material contains only traces of nitrogen.

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* See foot note, page 60.

PRECIPITATED PHOSPHATE OF LIME.

1488. Precipitated Phosphate of Lime. Made by the Carteret Chemical Co. of New York.

ANALYSIS.

Moisture at 100°	36.30
Loss on ignition (combined water)	8.14
Phosphoric Acid soluble in water	1.53
Phosphoric Acid, soluble in ammonium citrate	25.22
Phosphoric Acid, insoluble in " "	1.60
Lime	26.17

This is a by-product of chemical manufacture and consists largely of dicalcium phosphate.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

In a following table are given six analyses of fertilizers of this class with the prices at which they have been sold at retail in this State the past season.

We are informed by the manufacturer that the retail price of **1491** in Connecticut should be $30.00. Mr. Meeker writes that there are three parties in New Preston who offer the goods at $33 to $37 per ton. Similar discrepancies have been noted in the case of other brands.

Leaving out samples **1491** and **1494** which contain some potash, and assigning no value to reverted and insoluble phosphoric acid, soluble phosphoric acid has cost in these goods from 7.8 to 10.0 cents per pound, an average of 9 cents.

Valuing reverted at 8 cents and insoluble at 2 cents per pound, the soluble phosphoric acid has cost from 7.1 to 9.1 cents per pound, an average of 8.4 cents.

The following analyses, made at this Station during the year, of acid phosphate, from South Carolina rock will show the general nature of the material which is now most largely used in this country as a basis in the manufacture of ammoniated superphosphates.

Moisture	14.10					16.33	17.75
Soluble Phosphoric Acid,	16.28	14.24	12.08	11.89	10.76	9.94	13.33
Reverted Phosphoric Acid,	.44	1.48	2.22	1.78	1.43	1.73	
Insoluble Phosphoric Acid,	.09	.20	1.07	.06	0.00	.03	.82
Total Phosphoric Acid,	16.81	15.92	15.37	13.73	12.19	11.70	14.15

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1519	Dissolved Bone Black.	Geo. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1429	Pure Dissolved Bone.	H. J. Baker & Bro., 215 Pearl St., New York.	Dennis Fenn, Milford.	Dennis Fenn, Milford.
1524	High Grade Bone Superphosphate.	Mapes' Formula & Peruvian Guano Co., New York.	Mapes' Branch, Hartford.	Station Agent.
1491	Russell Coe Fertilizer Co's Soluble Bone Phosphate.	Russell Coe Fertilizer Co., 88 Wall St., New York.	....	E. E. Meeker, New Preston.
1494	Russell Coe Fertilizer Co's Soluble Bone Phosphate.	Russell Coe Fertilizer Co., 88 Wall St., New York.	....	M. S. Baldwin, Saugatuck.
1528	Acid Phosphate, 17–19 per cent.	H. J. Baker & Bro., 215 Pearl St., New York.	Manufacturer.	Station Agent. From J. J. Webb.
1380	Acid Phosphate.	H. J. Baker & Bro., 215 Pearl St., New York.	"	J. J. Webb, Hamden.

PLAIN (NON-NITROGENOUS) SUPERPHOSPHATES.

Station No.	Name or Brand.	Phosphoric Acid.							Cost per Ton.	Potash.
							Available			
		Soluble.	Reverted.	Insoluble.	Total Phos. Acid.	Phos. Acid Guaranteed.	Found.	Guaranteed.		
1519	Dissolved Bone Black, G. B. Forrester	17.75	.18	.08	18.01	....	17.93	....	$30.50*	....
1429	Pure Dissolved Bone, H. J. Baker & Bro.	15.83	1.24	.37	17.44	17.00	17.07	....	31.00†	....
1524	High Grade Bone Superphosphate, Mapes Co.	28.75	3.80	.93	33.48	....	32.55	33.00	58.00	....
1491	Russel Coe Fertilizer Co's Soluble Bone Phosphate	4.88	4.88	4.30	14.06	12.00	9.76	10.00	30.00	1.51
1494	Russel Coe Fertilizer Co's Soluble Bone Phosphate	6.53	3.90	5.49	15.92	12.00	10.43	10.00	31.00	2.14
1528	Acid Phosphate, 17–19 per cent., H. J. Baker & Bro.	18 57	.46	.07	19.10	....	19.03	....	....	....
1380	Acid Phosphate, H. J. Baker & Bro.	19.10	1.15	.46	20.71	....	20.25	....	29.42‡	....

* In Saugatuck. † $29.00 in New York. ‡ In New Haven.

AMMONIATED SUPERPHOSPHATES AND GUANOS.

This class includes all superphosphates containing nitrogen, (except such as are compounded for special crops; the so-called "special manures,") also Peruvian guano and fish fertilizers which have been acidulated and mixed with potash salts. The analyses of dry ground fish will be considered by themselves.

In considering the tables of analyses of ammoniated superphosphates the following points require special notice.

1.) *Guarantees.* Of the sixty analyses there are two which show the goods to be below the guarantee in every particular, in four cases the goods are below guarantee in two particulars, three are below guarantee as regards a single ingredient, while the remainder, 86 per cent. of the whole number, are above guarantee in all respects. (In several instances the guarantee is not given.) This showing is decidedly better than that of any previous year.

In some cases manufacturers have guaranteed "ammonia" instead of nitrogen, and "sulphate of potash" without stating the equivalent actual potash (K_2O). Such statements are in a measure misleading and do not meet the legal requirement.

2.) *Cost and Valuation:*

Excluding the Common Sense Fertilizer, No. 2, and the two samples of Charter Oak Fertilizer, in which the valuation is less than half the cost and the actual composition does not come up to the guarantee, the average cost of the 55 Superphosphates was \$37.60, the average valuation \$30.47, the difference \$7.13 or 23.4 per cent. of the valuation. The valuation, as has been explained, is designed to cover only retail cost of raw materials and does not cover cost of mixing, handling and selling. The 23.4 per cent. should represent the average cost of these last named items *plus* any profit which the manufacturer may have made.

The cost of mixing, handling and selling, and also profits are as legitimate and necessary items as cost of raw materials, consequently that cost should exceed the Station valuation is legitimate and necessary. That a fertilizer has a valuation higher than its cost does not prove that the manufacturer has lost money on it, nor does the fact that another is sold at a price far above valuation prove that the charge is exorbitant and covers a large profit. The cost of mixed fertilizers like that of most other things is largely governed by cost of production, and as a rule those firms which have the best facilities for getting their raw materials and

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1523	Pure Fine Bone, Dissolved in Sulphuric Acid.	Mapes' Formula & Peruvian Guano Co., New York.	Mapes' Branch, Hartford.	Station Agent.
1490	XXX Guano.	Tropic Guano Co., Elizabethport, N. J.	Usher & Tinker, Plainville.	"
1357	Americus Superphosphate.	Williams, Clark & Co., 101 Pearl St, New York.	R. B. Bradley & Co., New Haven.	"
1365	Lister's Standard Superphosphate of Lime.	Lister Bros., Newark, N. J.	S. J. Hall, Meriden.	"
1540	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport.	J. S. Kirkham, Newington.	T. R. Atwood, Newington.
1576	Americus Superphosphate.	Williams, Clark & Co., 101 Pearl St., New York.	J. P. Little, Columbia.	J. P. Little.
1362	Shoemaker's Swift Sure Superphosphate.	M. L. Shoemaker & Co., Philadelphia, Penn.	F. Ellsworth, Hartford.	Station Agent.
1369	Americus Superphosphate.	Williams, Clark & Co., 101 Pearl St., New York.	E. M. Jennings, Green's Farms.	Austin Jennings, Green's Farms.
1414	E. Frank Coe's High Grade Ammoniated Bone Superphosphate.	E. Frank Coe, 16 Burling Slip, New York.	J. P. Barstow, Norwich.	Station Agent.
1455	Mapes' Complete Manure for General Use.	Mapes' Formula & Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	"
1388	Acme Fertilizer, No. 2.	C. Meyer, Jr., Maspeth. L. I.	A. R. Russell & Co., Meriden.	"
1582	Dickenson's Bone Phosphate.	David B. Dickenson, Middle Haddam.	Manufacturer.	Oliver Brainard, East Hampton.
1510	Buffalo Fertilizer Works' Superphosphate [2].	Buffalo Chemical & Fertilizer Works, Buffalo, N. Y.	S. E. Case, New Hartford.	Station Agent.
1434	Niles' Special Fertilizer.	Chemical Ammoniate & Oil Co., Brooklyn, N. Y.	Geo. A. Niles, Danielsonville.	"

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by.
1492	Davidges' A. A. Ammoniated Bone Superphosphate.	Russell Coe Fertilizer Co., 88 Wall St., N. Y.	....	E. E. Meeker, New Preston.
1474	Sanford's Bone Superphosphate.	Chas. Sanford, Redding Ridge.	Sanford's Factory.	Turney Sanford, Redding.
1389	Bowker's Dissolved Ground Bone.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1372	G. W. Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.	Manufacturer.	Sent by Manf'r. Sampled by M. W. Terrell, Middlefield.
1385	Mapes' Complete Manure, "A" brand	Mapes' Formula & Peruvian Guano Co., 158 Front St., N. Y.	C. C. Hegemann & Co., Bridgeport.	Station Agent.
1394	Adams' Market Bone Fertilizer.	Adams & Thomas, Springfield, Mass.	A. W. Leighton & Co., 29 Broadway, New Haven.	"
1422	E. F. Coe's Alkaline Bone.	E. F. Coe, 16 Burling Slip, N. Y.	John O. Fox, Putnam.	"
1399	Darling's Animal Fertilizer.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	"
1432	Bosworth Bros'. Superphosphate of Lime.	Bosworth Bros., Putnam.	John A. Paine, Danielsonville.	"
1423	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	J. E. Leonard, Jewett City.	"
1478	Unicorn Ammoniated Superphosphate.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain & Co., Fair Haven.	Dealer.
1437	Royal Bone.	Williams, Clark & Co., New York City.	John A. Paine, Danielsonville.	Station Agent.
1416	Farmer's Friend Ammoniated Dissolved Bone.	Read & Co., New York.	M. V. B. Lamb, Norwich.	"
1390	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	"
1509	Ammoniated Bone Superphosphate.	Buffalo Fertilizer & Chemical Works, Buffalo, N. Y.	....	E. E. Meeker, New Preston.

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1387	Acme Fertilizer, No. 1.	C. Meyer, Jr., Maspeth, L. I.	A. R. Russell & Co., Meriden.	Station Agent.
1575	E. F. Coe's High Grade, Ammoniated Bone Superphosphate.	E. F. Coe, 16 Burling Slip, N. Y.	J. P. Little, Columbia.	J. P. Little, Columbia.
1397	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
1448	Original Coe's Superphosphate of Lime.	Bradley Fertilizer Co., Boston, Mass.	Smith & Sons, West Cornwall.	"
1454	G. W. Miles' Fish Fertilizer and Potash.	Geo. W. Miles Co., Milford.	Burtis & Mead, New Canaan.	"
1386	Bradley's Patent Superphosphate of Lime.	Bradley Fertilizer Co., Boston, Mass.	Wheeler & Howes, Bridgeport.	"
1411	Ammoniated Bone Superphosphate.	Buffalo Fertilizer Works, Buffalo, N. Y.	James Greenfield, New London.	"
1430	Stearn's Fish and Potash, No. 1.	Stearns & Co., 124 Front St., New York.	J. E. Leonard, Jewett City.	"
1551	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	Lewis Chamberlain, Coventry.	A. H. Pomeroy, Coventry.
1356	Quinnipiac Extra Superphosphate.	Quinnipiac Fertilizer Co., New London.	R. B. Bradley & Co., New Haven.	Station Agent.
1449	Excelsior Guano.	E. Frank Coe, 16 Burling Slip, New York.	Noble Bennett, New Milford.	"
1410	Common Sense Fertilizer [D].	Common Sense Fertilizer Co., Boston, Mass.	James Greenfield, New London.	"
1573	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	J. P. Little, Columbia.	J. P. Little, Columbia.
1450	Ammoniated Bone Superphosphate.	H. Preston & Sons, Greenpoint, L. I.	Smith & Sons, West Cornwall.	"
1470	U. S. Superphosphate.	Lister Bros., Newark, N. J.	Swan's Seed Store, Bridgeport.	"

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by.
1477	Great Planet, A.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain & Co., Fair Haven.	Dealer.
1395	Quinnipiac Fish and Potash, crossed fishes brand.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	Station Agent.
1506	Stearns' Ammoniated Bone Superphosphate.	Stearns & Co., New York.	The Platt Mill Co., Waterbury.	"
1504	Union County Fertilizer.	Union County Fertilizer Co., Linden, N. J.	Manufacturer.	Stephen Sanford, Redding Ridge.
1571	Quinnipiac Fish and Potash, plain brand.	Quinnipiac Fertilizer Co., New London.	J. P. Little, Columbia.	J. P. Little, Columbia.
1426	Mitchel's Superphosphate.	A. Mitchel, Linden, N. J.	Edward Fly, Putnam.	Station Agent.
1435	Williams, Clark & Co's Fish and Potash.	Williams, Clark & Co., New York.	John A. Paines, Danielsonville.	"
1580	Williams, Clark & Co's Fish and Potash.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1572	Quinnipiac Fish and Potash, crossed fishes brand.	Quinnipiac Fertilizer Co., New London.	" "	" "
1401	Soluble Pacific Guano.	Glidden & Curtis, Boston, Mass.	H. A. Stillman, Hartford.	Station Agent.
1382	Cooke's Blood Guano.	National Fertilizer Co., Bridgeport.	Swan's Seed Store, Bridgeport.	"
1586	Charter Oak Fertilizer.	Paul Thomson, Hartford.	Paul Thomson, Hartford.	G. M. Barbour & Sons, New Britain.
1419	Common Sense Fertilizer, No. 2.	Common Sense Fertilizer Co., 42 Congress St., Boston.	James Greenfield, New London.	Station Agent.
1452	Charter Oak Fertilizer.	Paul Thompson, Colt's Dyke, Hartford.	S. W. Elliott, Salisbury.	"
1498	Miles' I. X. L. Superphosphate.	G. W. Miles Co., Milford.	Manufacturer.	Henry Brown, 50 Chestnut St., New Haven.
1469	Bowker's Fish and Potash.	Bowker Fertilizer Co., 43 Chatham St., Boston.	L. H. Keirns, Bristol.	Station Agent.
1445	Standard Superphosphate.	New Haven Fertilizer Co.	Manufacturer.	Station Agent.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Station No.	NAME OR BRAND.	Nitrogen.		Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Valuation exceeds Cost.
									Available.						
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1523	Mapes' Pure Fine Bone, Dissolved in Sulphuric Acid	2.07	*2.06*	5.34	15.25	1.86	22.45	......	20.59	*12.00*	....	....	$35.00	$42.94	$7.94
1490	Tropic Guano Co's XXX Guano	1.66	*1.65*	6.22	7.89	4.75	18 86	......	14.11	*11.00*	4.55	*4.00*	33.00	37.47	4.47
															Cost exce'ds valua'n
1357	Americus Superphosphate	3.33	*1.65*	10.61	1.38	.70	12.69	*10.00*	11.99	.....	3.04	*2.00*	38.00	37.89	.11
1365	Lister's Standard Superphosphate	2 75	*2.34*	8.72	1.98	1.09	11.79	......	10.70	*10.00*	1.55	*1.50*	32.00	30.97	1.03
1540	Chittenden's Fish and Potash	4.72	*3.29*	3 81	3 16	.80	7.77	*6.00*	6.97	.....	4.90	*4.00*	35.00	33.71	1.29
1576	Americus Superphosphate	2.93	*1.64*	10.83	1.61	.33	12.77	*10.00*	12.44	*9.00*	2.74	*2.00*	38.00	36.48	1.52
1362	Shoemaker's Swift Sure Superphosphate	3.14	*2.47*	7.71	3.57	3.28	14.56	*14.00*	11.28	*9.00*	5.12	*2.17*	40.00	37.86	2.14
1369	Americus Superphosphate	2.72	*1.65*	11.19	1 39	.21	12.79	*10.00*	12.58	.....	2.24	*2.00*	38.00	35.27	2.73
1414	E. F. Coe's High Grade Superphosphate	2.30	*2.06*	8.17	2.22	1.91	12.30	......	10.39	*9 00*	1.68	*1.08*	34.00	30.30	3.70
1455	Mapes' Complete Manure, for General Use	5.71	*5.00*	7.70	3.32	1.97	12.99	*10.00*	11.02	.....	3.69	*3.00*	48.00	44.45	3 55
1388	Acme Fertilizer, No. 2	6.13	*5 10*	8.54	.15	.06	8.75	*8.50*	8.69	*8.00*	6.54	*5.00*	47.00	43.29	3.71
1582	Dickenson's Bone Phosphate	3.18	...	4.58	7.44	2.64	14.66	......	12.02	.....	2.92	....	40.00	36.17	3.83
1510	Buffalo Fertilizer Works Superphosphate. [2]	.11		11.43	2.44	.47	14.34	*13.00*	13.87	*11.00*	1.52	*1.35*	30.00	26.13	3.87

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	NAME OR BRAND.	Nitrogen.		Phosphoric Acid.					Available.		Potash.		Cost per Ton.	Valuation per Ton.	Cost exceeds Valuation.
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1434	Niles' Special Fertilizer	2.60	*2.69*	9.07	.89	.61	10.57	*11.23*	9.96	*10.00*	6.74	*5.12*	$38.00	$33.33	$4.67
1492	A. A. Ammoniated Bone Superphosphate	2.14	*2.06*	7.06	3.39	3.07	13.52	*12.00*	10.45	*9.00*	2.38	*1.50*	35.00	30.30	4.70
1474	Sanford's Bone Superphosphate.....	2.38	*1.65*	4.05	2.55	5.90	12.50	*8.00*	6.60	.....	6.50	*2.00*	35.00	30.19	4.81
1389	Bowker's Dissolved Ground Bone....	2.23	*2.06*	9.69	1.17	.63	11.49	*10.00*	10.86	*8.00*	2.34	*2.16*	35.00	29.83	5.17
1372	G. W. Miller's Raw Bone Phosphate,	4.89	....	4.44	3.83	.49	8.76	......	8.27	.....	5.23	....	42.00	36.56	5.44
1385	Mapes' Complete Manure, "A" Brand	2.62	*2.47*	7.13	4.19	3.31	14.63	......	11.32	*10.00*	3.23	*2.50*	40.00	34.36	5.64
1394	Adams' Market Bone Fertilizer......	3.40	*3.50*	4.51	5.14	.96	10.61	*10.00*	9.65	.....	3.43	*3.00*	38.00	32.27	5.73
1422	Coe's Alkaline Bone..............	1.39	*.82*	7.46	2.46	2.29	12.21	......	9.92	*9.00*	1.52	....	32.00	26.04	5.96
1399	Darling's Animal Fertilizer.........	4.43	*3.29*	.65	6.55	3.51	10.71	*10.00*	7.20	.....	5.39	*4.00*	42.00	34.99	7.01
1432	Bosworth's Superphosphate of Lime,	2.23	*2.00*	4.94	5.25	4.51	14.70	*13.00*	10.19	*11.00*	2.77	*2.00*	38.00	31.28	6.72
1423	Bay State Fertilizer................	3.42	*2.40*	9.12	.80	1.06	10.98	*9.50*	9.92	*8.00*	2.82	*2.00*	40.00	33.26	6.74
1478	Unicorn Ammoniated Superphosphate.........................	2.69	*1.85*	7.10	1.37	2.42	10.89	......	8.47	*8.50*	2.47	*2.25*	36.00	29.05	6.95
1437	William Clark & Co's Royal Bone ..	1.14	*.82*	4.25	3.24	1.31	8.80	*7.00*	7.49	.....	2.69	*2.00*	27.50	20.40	7.10
1416	Farmer's Friend Ammoniated Dissolved Bone....................	2.46	*1.82*	7.15	2.11	1.18	10.44	......	9.26	*8.00*	2.14	*2.00*	35.00	27.87	7.13
1390	Bowker's Hill and Drill Phosphate..	2.80	*2.50*	8.88	1.16	.74	10.78	*11.00*	10.04	.....	2.59	*2.00*	38.00	30.71	7.29
1509	Buffalo Fertilizer Co's Bone Superphosphate....................	3.35	*2.90*	7.82	1.82	2.23	11.87	......	9.64	*8.00*	1.64	*1.00*	40.00	32.22	7.78

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	NAME OR BRAND.	Nitrogen.		Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost exceeds Valuation.
									Available.						
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.			
1387	Acme Fertilizer, No. 1	4.36	*3.70*	8.37	.10	.06	8.53	*8.50*	8.47	*8.00*	9.35	*9.00*	$47.00	$38 93	$8.07
1575	Coe's Ammoniated Superphosphate	2.46	*2.06*	7.78	1.92	1.50	11.20	*10.00*	9.70	*9.00*	3.47	*2 00*	40.00	31.84	8.16
1397	Quinnipiac Phosphate	3.25	*2.47*	7.86	1.97	.73	10.56	......	9.83	*8.00*	2.37	*2.00*	40.00	31.59	8.25
1448	Original Coe's Superphosphate of Lime	2.69	*2.05*	8.56	1.80	1.76	12.12	......	10.36	*9.00*	....	....	38.00	29.38	8.62
1454	Geo. W. Miles' Fish Fertilizer and Potash	2.52	*2.47*	6.16	1.06	2.09	9.31	......	7.22	*5.00*	3.23	*3.00*	35.00	26 28	8.72
1386	Bradley's Patent Superphosphate of Lime	2.70	*2.27*	8.59	2.15	1.56	12.30	......	10.74	*9.00*	1.51	*1.50*	40.00	31.15	8.85
1411	Buffalo Fertilizer Co's Bone Superphosphate	3.07	*2.90*	8.43	1.68	.85	10.96	......	10.11	*8.00*	1.73	*1.00*	40.00	31.06	8.94
1430	Stearns' Fish and Potash, No. 1	2.54	*2.47*	2.80	2.10	5.02	9.92	......	4.90	*3.00*	4.86	*4.00*	35.00	25.69	9.31
1551	Bay State Fertilizer	2.95	*2.06*	7.56	1.68	1.90	11.14	......	9.24	*9.00*	3.42	*2.00*	40 00	30.55	9.45
1356	Quinnipiac Extra Superphosphate	2.34	*1.43*	6.14	2.65	1.05	9.84	*10.00*	8.79	*8.00*	2.14	*2.00*	36.00	26.37	9.63
1449	Coe's Excelsior Guano	3.69	*3.29*	8.59	1.06	1.30	10.95	*10.00*	9.65	....	2.83	*2.70*	45.00	35.27	9.73
1410	Common Sense Fertilizer, [D]	1.09	*1 00*	.64	1.86	.38	2.88	*2.00*	2.50	....	1.80	*1.00*	20.00	9.88	10.12
1573	Quinnipiac Phosphate	3.01	*2.50*	7.64	1.54	.35	9.53	*9.00*	9.18	*8.00*	2.30	*2.00*	40.00	29.29	10.71
1450	Preston's Ammoniated Bone Superphosphate	2.57	*2.50*	6.48	1.68	2.02	10.18	......	8.16	*10.00*	1.85	*2.00*	37.50	26.78	10.72
1470	U. S. Superphosphate	1.72	*1.31*	5.37	1.78	.55	7.70	......	7.15	*6.00*	2.52	*2.00*	32.00	21.28	10.72
1477	Great Planet A	3.95	*3.29*	6.02	1.12	1.06	8.20	......	7.14	*7.00*	11.05	*9.50*	48.00	37.15	10.85

NITROGENOUS SUPERPHOSPHATES AND GUANOS—*Continued.*

Station No.	NAME OR BRAND.	Nitrogen.		Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.	Cost exceeds Valuation.
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.			
									Found.	Guaranteed.					
1395	Quinnipiac Fish and Potash, crossed fishes brand	3 55	*3.25*	.66	3.41	3.17	7.24	*5.00*	4.07	*3.00*	3.90	*3.00*	$38.00	$27 03	$10.97
1506	Stearns' Ammoniated Bone Superphosphate	2.65	*2.27*	7.71	1.49	.91	10.11	......	9.20	*8.00*	2.83	*2.00*	40.00	28 94	11.06
1504	Union County Fertilizer	1.08	*1.65*	3.38	1.55	5.36	10.29	*8.00*	4.93	.....	2.39	*2.00*	30.00	18.77	11.23
1571	Quinnipiac Fish and Potash, plain brand	2.72	*2.00*	1.52	4.22	1.84	7.58	*6.00*	5.74	*4.00*	4.58	*4.00*	36.00	24.64	11 36
1426	Mitchel's Superphosphate	1.31	*2.06*	6.15	3.09	1.15	10.39	*10.00*	9.24	*8.00*	1.28	*3.00*	35.00	22.74	12.26
1435	Williams, Clark & Co's Fish and Potash	3.35	*3.29*	.52	4.07	2.71	7.30	*3.00*	4.59	.....	4.64	*3.00*	38.00	25.62	12.38
1580	Williams, Clark & Co's Fish and Potash	3.10	*3.29*	.37	2.67	3.93	6.97	*3.00*	3.04	.....	4.36	*3.00*	36 00	23.05	12.95
1572	Quinnipiac Fish and Potash, crossed fishes brand	3.62	*3 50*	.95	3.93	1.27	6.15	*5.00*	4.88	*3.0*	3.57	*3.00*	39.00	25 09	13.91
1401	Soluble Pacific Guano	2.72	*2.00*	7.75	1.91	2.57	12.23	......	9.66	*8.00*	1.75	*2.00*	45.00	30.34	14.66
1382	Cooke's Blood Guano	1.35	*1.24*	5.16	2.94	1.50	9.60	......	8.10	*7.00*	1.71	....	38.00	21.50	16.50
1586	Charter Oak Fertilizer	1.00	*1.65*	.00	.77	.76	1.53	......	.77	*2.50*	1.79	*2.00*	25.00	6.96	18.01
1419	Common Sense Fertilizer, No. 2	1.65	*2.00*	.10	3.08	.88	4.06	*4.00*	3.18	.....	2.72	*3.00*	35.00	14.06	20.94
1452	Charter Oak Fertilizer	1.18	*1.65*	trace	.95	.28	1.23	......	.95	*2.50*	2.67	*2.00*	30.00	8 26	21.74
1498	Miles' I. X. L. Superphosphate	2.17	....	6 27	1.72	3.59	11.58	......	7.99	.....	1.98	....	......	26.40	.....
1469	Bowker's Fish and Potash	2.62	*2.25*	4.66	2.18	1.14	7.98	*8.00*	6.34	.....	4.94	*4.00*	......	26 42	.....
1445	N. H. Fertilizer Co's Superphosphate	2.77	....	6.54	1.60	.37	8.51	......	8.14	.....	3.14	....	......	28.76	.....

for manufacturing, will sell at prices least above valuation and still make a fair profit. Of course this rule does not hold when different concerns indulge in the expensive luxury of making war on each other by reducing prices so as to allow no profit.

It will be noticed that in two cases the valuation is more than the cost, in 14 cases valuation is less than $5.00 below cost, in 24 it is between $5 and $10 below, and in 14 between $10 and $15 below cost.

The large manufacturers mostly appear to desire that their goods shall be retailed at a uniform rate throughout the State, and when, as sometimes happens, a local dealer by accident or intent charges or reports a price in advance of that commonly charged, the manufacturer is aggrieved to find in the Station publications that his goods are reported as dearer than he intended.

The purchaser is also made unhappy by finding that he has paid for a brand of superphosphate a higher price than others have got it for.

The Station gives what information it is able to gather relative to retail prices and will use its best efforts to fully represent the facts.

3. *The Drawing of Samples.*

19 of the samples under discussion were drawn by others than the Station agents. A number of analyses of samples so drawn have been omitted from the report because there was good reason to believe that they were not properly taken and a published analysis of a sample improperly taken works injury to all parties.

Objection is sometimes made that the whole annual output of a given brand of goods is judged by the results of a single analysis which may or may *not* be a fair representative.

It is out of the question for the Station with its present means to double or more than double the work done on fertilizers, by making a larger number of analyses. Another plan which has been tried in two or three cases this year is to draw as many samples of each brand as possible and make a careful mixture of equal portions of each sample. The analysis of this mixture then represents the average of a large number of analyses made on different samples.

To illustrate:—below are given

1. Analysis of a mixture of 2 samples of H. J. Baker's Pelican Bone Fertilizer; one drawn at Winsted, cost $35, and one at

Litchfield, cost $33. The manufacturer writes that "the retail price all through Connecticut should be $32.50 as published in our pamphlets." Guaranteed nitrogen 1.85—Available phos. acid 8—Potash 2.25.

2. Analysis of a mixture of 2 samples of H. J. Baker's A. A. Ammoniated Superphosphate; one drawn in West Cornwall, the other in Litchfield. Cost of each $37.50. Guaranteed nitrogen 2.47—Available phos. acid 10—Potash 2.

3. Analysis of a mixture of 7 samples of Williams, Clark & Co's Americus Ammoniated Superphosphate drawn in New London, New Milford, East Canaan, Washington Depot, Danbury, New Canaan and East Haddam. Cost prices were $40, $37, $36, $38, $35, $38, $35. Guaranteed nitrogen 1.65—Available phos. acid 9—Potash 2.

	Pelican Bone Fertilizer.	A. A. Super-phosphate.	Americus Superphos-phate.
Nitrogen,	2.39	2.80	2.76
Soluble Phosphoric Acid,	9.50	11.50	10.26
Reverted Phosphoric Acid,	1.15	.54	1.24
Insoluble Phosphoric Acid,	.38	.17	.81
Potash,	2.86	2.62	2.77
Average Valuation per ton,	$30.27	$34.01	$34.75

4. *Certain analyses call for special notice.*

Miles I. X. L. Superphosphate **1498** was bought at an auction sale.

1586 and **1452** are samples of the Charter Oak Fertilizer made by Paul Thomson of Hartford.

A more complete analysis of **1452** is as follows:—

Water,	22.54
Sand and Soil,	43.51
Organic matter,	12.70
(Containing 1.18 per cent. nitrogen.)	
Phosphoric Acid,	1.23
Potash soluble in Water,	2.67
Other matters (by difference,)	17.35
	100.00

More than three-fifths of this "fertilizer" is made up of sand and water. Its cost is more than three and one half times its valuation.

The "Common Sense" Fertilizer D, **1410,** costs more than twice as much as its valuation and the "Common Sense" Fertilizer No. 2, **1419**, costs about two and a half times as much as its valuation.

1500 No. 1 Standard Peruvian Guano. Sold by Hurtado & Co., 16 and 18 Exchange Place, New York. From stock of Southmayd and Gardiner, Middletown. Sample drawn by Station agent.

ANALYSIS.

	Found.	Guaranteed.
Nitrogen,	7.44	7.41
Soluble Phosphoric Acid,	3.78	
Reverted Phosphoric Acid.	3.58	
Insoluble Phosphoric Acid,	4.48	
Total Phosphoric Acid,	11.84	12.00
Potash,	1.87	2.00
Cost,	$65.00	

If calculated in the usual way, the valuation of this article would be $44.48.

In regard to its valuation, Messrs. Hurtado & Co. write, under date of May 9, 1885 : "The Chilian government fixes the prices at 21 shillings per unit of nitrogen and 4 shillings sixpence per unit of phosphoric acid in the ton of 2240 pounds. However exorbitant these figures may be, the goods cannot be purchased any lower, and we believe that some mention of it could be made in order to show the cost of the raw material, which is higher than any other, and therefore the valuation of our goods, based on the average price of other and cheaper articles, does not seem to us an equitable one. We notice that a different valuation is placed upon the nitrogen of coarse bone, hair and fish scraps than upon that of nitrates and ammonia salts, because the latter command a higher wholesale price; the same should apply to Peruvian Guano."

At 21 shillings per unit in ton of 2240 pounds nitrogen costs 22½ cents per pound. Phosphoric acid at 4 shillings sixpence the unit, costs 4¾ cents per pound. These are *wholesale prices* in Chili; a fair retail price here would raise these figures very considerably and it is evident that our schedule of valuations applied to genuine Peruvian Guano without any explanation would be unfair to the dealer. It would serve the purpose however of comparing Peruvian Guano with other commercial fertilizers, on a money basis, and would suggest at once the question whether it would pay to use guano while the Chilian government put such a high price on it.

Genuine Peruvian Guano is understood to contain a considerable portion of nitrogen as uric acid and urates of the alkalies. These are not readily soluble in water. The uric acid can be very readily detected even when present in minute quantity. Genuine Peruvian Guano contains also a small amount of sulphuric acid, 2–3 per cent. on the average.

The sample of "No. I Standard Peruvian Guano" **1500** contains *no trace* of uric acid, more than 84 per cent. of the nitrogen in it is in the form of ammonia salts *readily soluble* in water, and it contains 13.67 per cent. of sulphuric acid soluble in water. It has the color and somewhat the odor of Peruvian Guano, but in our judgment is not wholly that, but a mixture of some genuine guano with considerable sulphate of ammonia and possibly other materials.

In the next table are given eight analyses of "Manufacturers' Samples." The Station is required to "cause one or more analyses of each fertilizer to be made and published annually." Its agents have not succeeded in obtaining samples of certain brands from the retail market, and it is therefore obliged to analyze the samples which have been sent by the manufacturers.

For more convenient reference the various brands of Fish and Potash are tabulated by themselves on page 82. Their average cost has been $36.70, average valuation $26.64, and difference between the two is 35½ per cent. of the valuation. They have therefore been more expensive fertilizers than other superphosphates.

A STATEMENT.

In April last a supply of a fertilizer was sent to several agents in this State for sale, from one of whom samples were drawn by the Station and analyzed. The analyses showed the goods to be well above the manufacturer's minimum guarantee. They were reported to the manufacturer who claimed that a mistake had been made in the grade of goods shipped and that the grade shown by the analyses was not as high as was expected and intended for the Connecticut trade. He requested the analyses to be withheld from publication and promised to immediately withdraw the goods from the State. The Executive Committee, at a meeting held April 17th, ordered the analyses to be withheld from publication and this statement to be published in the Annual Report.

Manufacturers' Samples of Ammoniated Superphosphates.

Station No.	NAME.	Nitrogen.		Phosphoric Acid.							Potash.		Cost per Ton.	Valuation per Ton.
									Available.					
		Nitrogen Found.	Nitrogen Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.		
1557	Bradley's B. D. Sea-Fowl Guano	2.37	*2.50*	8.14	2.76	1.00	11.90	*11.00*	10.90	*9.00*	1.36	*2.00*	...	$29.54
1558	Bradley's "Circle Brand" Bone and Potash	1.96	*1.85*	3.05	5.28	2.38	10.71	*8.00*	8.33	....	2.76	*2.00*	....	25.25
1552	Buffalo Fertilizer Co's Queen City Phosphate	1.88	*1.65*	7.38	1.79	.64	9.81	*9.00*	9.17	*8.00*	1.67	*1.00*	....	24.85
1562	G. H. Harris' Pure Bone Phosphate	2.50	*3.00*	2.82	5.64	2.18	10.64	*17.00*	8.46	....	....	....	....	24.84
1553	Shoemaker's Good-enough Phosph.	1.83	*1.24*	7.02	4.40	2.41	13.83	*12.00*	11.42	*8.00*	2.16	*1.60*	....	30.03
1559	Shoemaker's Echo Phosphate	1.34	*.82*	4.47	3.74	3.41	11.62	*9.00*	8.21	*7.00*	1.99	*1.08*	....	23.27
1556	Sparrow's B. B. Phosphate	2.34	....	8.12	2.96	.58	11.66	....	11.08	....	2.74	....	....	30.57
1554	Wilkinson's Ammoniated Superphosphate	2.84	*2.50*	10.43	1.25	.16	11.84	....	11.68	*10.00*	3.37	*3.00*	....	33.97

FISH AND POTASH.

	Chittenden's.	George W. Miles'.	Stearns'.	Quinnipiac's Crossed-Fishes.	Quinnipiac's Crossed-Fishes.	Quinnipiac's Plain Brand.	Williams, Clark & Co's	Williams, Clark & Co's	Bowker's.
	1540	1454	1430	1395	1572	1571	1435	1580	1460
Nitrogen	4.72	2.52	2.54	3.55	3.62	2.72	3.35	3.10	2.62
Soluble Phosphoric Acid	3.81	6.16	2.80	.66	.95	1.52	.52	.37	4.66
Reverted Phosphoric Acid	3.16	1.06	2.10	3.41	3.93	4.22	4.07	2.67	2.18
Insoluble Phosphoric Acid	.80	2.09	5.02	3.17	1.27	1.84	2.71	3.93	1.14
Potash	4.90	3.23	4.86	3.90	3.57	4.58	4.64	4.36	4.94
Cost	$35.00	$35.00	$35.00	$38.00	$39.00	$36.00	$38.00	$36.00	....
Valuation	$33.71	$26.28	$25 69	$27.03	$25.09	$24.64	$25.62	$23.05	$26.42
Nitrogen Found	4.72	2.52	2.54	3.55	3.62	2.72	3.35	3.10	2.62
Nitrogen Guaranteed	*3.29*	*2.47*	*2.47*	*3.25*	*3.50*	*2.00*	*3.29*	*3.29*	*2.25*
Phosphoric Acid Found	7.77	9.31	9.92	7.24	6.15	7.58	7.30	6.97	7.98
Phosphoric Acid Guaranteed	*6.00*	....	....	*5.00*	*5.00*	*6.00*	*3.00*	*3.00*	*8.00*
Potash Found	4.90	3.23	4.86	3.90	3.57	4.58	4.64	4.36	4.94
Potash Guaranteed	*4.00*	*3.00*	*4.00*	*3.00*	*3.00*	*4.00*	*3.00*	*3.00*	*4.00*

HOME-MIXED FERTILIZERS.

Following are two analyses of a home-mixed fertilizer prepared by J. J. Webb, of Hamden. The ingredients used and their prices were

12000 lbs. acid phosphate @ $28.00 per ton	$168.00
4145 lbs. muriate potash @ 1.8 cts. per lb.	77.76
4084 lbs. sulphate of ammonia @ 3¼ cts per lb.	132.73
Freight bills to New Haven	15.15
20229	$393.64

Or $38.91 per ton for the goods in New Haven, unmixed.

The two samples, **1481** and **1489**, were drawn by different persons at different times. With the analyses is given the *calculated* composition of the mixture derived from analyses made at this Station, of the materials used :

	Calculated.	1481.	1489.
Nitrogen	4.19	4.07	4.30
Soluble Phosphoric Acid	....	11.77	....
Reverted Phosphoric Acid	....	.71	....
Insoluble Phosphoric Acid	....	.25	....
Total Phosphoric Acid	12.28	12.73	12.73
Potash	10.61	10.50	10.23
Valuation	$45.91	46.10	46.71

The crude materials were bought in New York in February.

Later in the season (July) another mixture made by Mr. Webb was analyzed. It was compounded according to the following formula:

Dissolved Bone Black	4,000	pounds.
Bone and Blood (Tankage)	6,205	"
Sulphate of Ammonia	1,251	"
Muriate of Potash	2,000	"
	13,456	"

One sample of this mixture was drawn by Mr. Webb, another by a Station agent.

The analyses follow together with the calculated composition derived from analyses of the raw materials :

	Formula.	Mr. Webb's Sample. 1588.	Station Sample. 1589.
Nitrogen	5.20	5.02	5.09
Soluble Phosphoric Acid		6.15	6.20
Reverted Phosphoric Acid		1.75	2.65
Insoluble Phosphoric Acid		1.54	.62
Total Phosphoric Acid	9.09	9.44	9.47
Potash	7.76	8.05	8.10
Valuation per ton		$40.01	$41.09

The composition of the two samples is almost identical. They contain somewhat more potash and phosphoric acid and a little less nitrogen than corresponds to the formula, but the agreement is as close as could be expected.

The total cost of the materials (13,456 pounds) delivered in New Haven, was stated by Mr. Webb to be $215.06 or $31.96 per ton.

1508. Home-mixed Tobacco Fertilizer. Sampled and sent by Abner Trask, East Hartford. It is stated to consist of a mixture of

2,000	pounds	Cotton Seed Meal.
1,000	"	Cotton Hull Ashes.
500	"	Lime.
500	"	Plaster.
4,000		

and to cost $25.42 per ton. Whether this includes the cost of mixing, is not stated.

1475. Home-mixed fertilizer sent by J. M. Brown, Poquonnock, made according to the same formula as Mr. Trask's sample. Price "about $26.00."

ANALYSES.

	1508.	1475.
Nitrogen	3.37	3.52
Soluble Phosphoric Acid	Trace	Trace
Reverted Phosphoric Acid	2.08	5.01
Insoluble Phosphoric Acid	.12	.27
Potash,	5.44	6.64
Valuation	$23.40	$30.43

1479. Home-mixed Potato Fertilizer. Made by W. F. Andross, East Hartford, according to the following formula:

850 pounds Mapes' Dissolved Bone.
400 pounds Bowker's Dry Fish.
400 pounds H. J. Baker & Co's Castor Pomace.
350 pounds Muriate of Potash.
2000

With regard to it Mr. Andross writes: "Its actual cost is $33 per ton, allowing the chemicals at the retail market price, which the farmer generally has to pay when he mixes his own formulas. This allows nothing for labor for mixing. I have had as good success with this mixture for the past three years under test conditions as I have had with any of the best manufactured specials for potatoes and root crops, corn or cabbage, varied to suit the requirements of the crop. I have never found anything better and I can save from 30 to 40 per cent. in the cost of the goods."

ANALYSIS.

Nitrogen	4.05
Soluble Phosphoric Acid	1.92
Reverted Phosphoric Acid	10.35
Insoluble Phosphoric Acid	1.50
Potash	7.09
Valuation per ton	$41.83

A fertilizer perfectly mixed according to the formula given would contain not far from 3.6 per cent. of nitrogen, 11.4 per cent. phosphoric acid and 9.0 per cent. of potash and its valuation per ton would be about $38.00. The explanation of this discrepancy is either that the goods which were mixed were not correctly weighed or that the sample did not fairly represent the goods.

SPECIAL FERTILIZERS.

Twenty-six analyses of this kind of ammoniated superphosphates are tabulated below. Eleven of them were drawn by others than Station agents. Seven of them are below their guarantee as regards one ingredient and one of them as regards two ingredients.

Their average cost has been $44.80 and average valuation $38.70. The difference, $6.10, is less than 16 per cent. of the valuation. It appears this year, as last, that the special fertilizers are generally of higher grade than the other ammoniated superphosphates, and if the quality of materials used in their manufacture is the same, are cheaper sources of plant food than other superphosphates. The reasons for this were discussed in the last Report and do not call for further notice here.

1465 is a mixture of equal parts of two samples, one from West Cornwall, the other from Newtown. The cost was the same in both places.

SPECIAL MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1514	Forrester's Onion Manure.	Geo. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1502	Mapes' Tobacco Manure for use with Stems.	Mapes Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	Station Agent.
1418	Mapes' Grass and Grain Spring Top Dressing.	Mapes Formula and Peruvian Guano Co., 158 Front St., N. Y.	J. P. Barstow, Norwich.	"
1458	Mapes' Tobacco Manure, Conn. Brand.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	"
1513	Forrester's Potato Manure.	G. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1512	Forrester's Corn Manure.	G. B. Forrester, 169 Front St., New York.	Manufacturer.	S. B. Wakeman, Saugatuck.
1483	Mapes' Potato Manure.	Mapes' Formula and Peruvian Guano Co., New York.	Josiah Hawkins, Southport.	Edward Osborn, Fairfield.
1468	Americus Brand Tobacco Fertilizer.	Williams, Clark & Co., 101 Pearl St., New York.	E. S. Roberts, East Canaan.	Station Agent.
1384	Mapes' Complete Manure for Potatoes.	Mapes Formula and Peruvian Guano Co., New York.	C. C. Hegemann, Bridgeport.	"
1471	Chittenden's Complete Fertilizer for Tobacco.	National Fertilizer Co., Bridgeport.	J. S. Kirkham, Newington.	Thos. R. Atwood, Newington.
1392	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1472	Chittenden's Grain Fertilizer.	National Fertilizer Co., Bridgeport.	John S. Kirkham, Newington.	Joshua Belden, Newington.
1473	Chittenden's Root Fertilizer.	National Fertilizer Co., Bridgeport.	John S. Kirkham, Newington.	Joshua Belden, Newington.

SPECIAL MANURES—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1579	Americus Potato Fertilizer.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1391	Stockbridge Vegetable Manure.	Bowker Fertilizer Co., New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1400	Potato, Hop and Tobacco Phosphate.	L. L. Crocker, Buffalo, N. Y.	H. A. Stillman, Hartford.	"
1465	Complete Potato Manure.	H. J. Baker & Bro., New York.	....	"
1421	Ralston's Potato Fertilizer.	John Ralston, 16 Burling Slip, New York.	Arnold Rudd, New London.	"
1447	Bradley's Complete Manure for Potatoes and Roots.	Bradley Fertilizer Co., Boston Mass.	Strong & Tanner, Winsted.	"
1428	Americus Brand Potato Fertilizer.	Williams, Clark & Co., New York.	John A. Paine, Danielsonville.	"
1497	Davidge Brand Potato Manure.	Russell Coe Fertilizer Co., 88 Wall St., New York.	M. S. Baldwin, Naugatuck.	M. S. Baldwin, Naugatuck.
1392	Stockbridge Grain Manure.	Bowker Fertilizer Co, New York and Boston.	Coburn & Gale, Hartford.	Station Agent.
1406	Chittenden's Complete Fertilizer for Roots.	National Fertilizer Co., Bridgeport.	Wm. Fowler, Milford.	"
1462	Baker's Complete Corn Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. S. Smith, Kent.	"
1511	Stockbridge Potato Manure.	Bowker Fertilizer Co., New York and Boston.	Hubbell & Bradley, Saugatuck.	S. B. Wakeman, Saugatuck.
1555	Bradley's Complete Manure for Corn and Grain.	Bradley Fertilizer Co, Boston.	Manufacturer's Sample.	Manufacturer.

SPECIAL MANURES.—ANALYSES AND VALUATIONS.

Station No.	NAME OR BRAND.	Nitrogen.		Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Valuation Exceeds Cost.
									Available.							
		Found.	Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
1514	Forrester's Onion Manure......	6.21	*5.35*	7.79	.09	.12	8.00	......	7.88	*3.50*	7.65	*7.00*	2.89	$45.00	$45.41	$ .41
																Cost Exceeds Valuation.
1502	Mapes' Tobacco Manure for use with Stems................	6.15	*5.35*	7.80	3.46	2.69	13.95	*10.50*	11.26	.....	3.90	*3.50*	.82	50.00	48.88	$1.12
1418	Mapes' Grass and Grain Spring Top Dressing	5.54	*4.12*	7.68	3.10	.84	11.62	*7.00*	10.78	.....	6.75	*5.00*	6.07	47.00	45.13	1.87
1458	Mapes' Tobacco Manure, Conn. Brand....	5.43	*4.74*	6.75	3.03	.98	10.76	*7.75*	9.78	.....	7.79	*7.75*	.88	50.00	47.93	2.07
1513	Forrester's Potato Manure......	4.91	*3.50*	5.68	.28	.27	6.23	......	5.96	*5.25*	10.42	*10.00*	1.05	45.00	42.84	2.16
1512	Forrester's Corn Manure.........	4.82	*3.91*	8.87	.11	.22	9.20	......	8.98	*6.50*	9.69	*8.00*	7.38	45.00	41.92	3.08
1483	Mapes' Potato Manure...........	4.27	*3.70*	8.70	2.72	.69	12.11	*8.00*	11.42	.....	7.75	*6.00*	3.59	48.00	44.31	3.69
1468	Americus Brand Tobacco Fertilizer...	3.96	*4.12*	5.13	1.13	.13	6.39	......	6.26	*4.00*	10.07	*8.00*	2.40	42.00	38.09	3.91
1384	Mapes' Complete Manure for Potatoes....................	4.08	*3.70*	8.13	2.54	1.37	12.04	......	10.67	*8.00*	7.55	*6.00*	3.95	48.00	44.04	3.96
1471	Chittenden's Complete Fertilizer for Tobacco................	4.30	*3.29*	4.82	4.17	3.84	13.13	*10.00*	9.29	*6.00*	4.74	*4.32*	.90	45.00	40.54	4.46
1393	Stockbridge Forage Crop Manure.	5.43	*5.50*	6.49	1.00	.92	8.41	*6.00*	7.49	*5.00*	2.98	*2.50*	1.29	42.50	36.85	5 65
1472	Chittenden's Grain Fertilizer....	4.30	*3.70*	5.28	4.43	2.40	12.11	*8.00*	9.71	*6.00*	6.04	*5.00*	5.79	45.00	39.12	5.88

SPECIAL MANURES.—*Continued.*

Station No.	NAME OR BRAND.	Nitrogen.		Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Cost Exceeds Valuation.
		Found.	Guaranteed.	Soluble in Water.	Reverted.	Insoluble.	Total Phos. Acid Found.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.				
									Found.	Guaranteed.						
1473	Chittenden's Root Fertilizer......	4.40	*3.29*	5.47	3.35	2.22	11.04	*8.00*	8.82	*6.00*	6.08	*6.00*	5.85	$45.00	$38.00	7.00
1579	Americus Potato Fertilizer	3.31	*2.47*	6 16	.98	.18	7.32	*6.00*	7.14	*5.00*	7.94	*8.00*	1.08	43.00	35.37	7.63
1391	Stockbridge Vegetable Manure..	3.80	*3.25*	6.54	1.01	1.11	8.66	......	7.55	*8.00*	7.11	*7.00*	6.49	42.50	33.99	8.51
1400	Potato, Hop and Tobacco Phosphate....................	2.90	*2.00*	7.13	1.93	1.30	10.36	*9.00*	9.06	*8.00*	5.68	*3.50*	5.07	40.00	32.19	7.81
1465	Baker's Complete Potato Manure	3.35	*3.30*	5.45	.90	.14	6.49	*5.25*	5.35	.....	10.34	*10.00*	2.15	45.00	36.70	8.30
1421	Ralston's Potato Fertilizer.......	1.73	*1.65*	7.90	1.52	1.86	11.29	......	9.43	*8.00*	4.91	*3.70*	.57	40.00	31.00	9.00
1447	Bradley's Complete Manure for Potatoes and Roots...........	3.14	*3.29*	8.58	1.61	1.39	11.58	......	10.19	*8.00*	6.38	*4.50*	5.89	45.00	35.85	9.15
1428	Americus Brand Potato Fertilizer	3.04	*2.47*	6.16	1.19	.14	7.49	*6.00*	7.35	*5.00*	8.55	*8.00*	1.14	45.00	35.53	9.47
1497	Davidge Brand Potato Manure...	2.09	*2.47*	5.92	5.39	3.85	15.16	......	11.31	*8.00*	5.22	*4.10*	4.68	44.00	34.32	9.68
1392	Stockbridge Grain Manure.......	3.80	*3.25*	7.71	1.86	.67	10.24	*7.00*	9.57	*6.00*	4.66	*4.00*	5.05	42.50	35.03	7.47
1406	Chittenden's Complete Fertilizer for Roots, Potatoes and Vegetables....................	3.84	*3.29*	6.27	1.57	1.20	9.04	*8.00*	7.84	*6.00*	7.60	*6.00*	6.49	45.00	35.04	9.96
1462	Baker's Complete Corn Manure..	4.70	*5.00*	6.04	.40	.09	6 53	......	6.44	*6.25*	7.68	*7.00*	9.99	45.00	35.03	9.97
1511	Stockbridge Potato Manure.....	3.81	*3.29*	6.79	.57	.95	8.31	......	7.36	.....	6.40	*7.00*	3.89	45.00	33.79	11.21
1555	Bradley's Complete Manure for Corn and Grain	2.93	*3.30*	8.60	1.78	1.33	11.71	......	10.38	*9.00*	6.03	*4.00*	5.46	.....	35.08	

BONE MANURES.

On the following pages are tabulated 30 analyses of articles of this class; 15 of the samples were drawn by a station agent, and 15 by other parties.

Ivory sawdust, **1405**, is a perfect fertilizer of this class. It has every appearance of being pure bone, it is white and clean, its content of nitrogen and phosphoric acid is exceptionally high, and its mechanical condition is excellent.

Peter Cooper's bone, **1404** and **1354**, is a residue from glue manufacture and a considerable portion of nitrogen has been removed in form of glue.

The low per cent. of nitrogen and phosphoric acid in **1349** is due to the large amount of water present. The material is produced by sawing bone in water.

Samples **1363, 1583, 1420, 1525,** all contain more or less sulphate of soda and salt, which are used as dryers and preservatives.

The average cost of the bone manures has been $34.59; the average valuation $34.58.

The method of valuation applied to bone is explained on page 62.

BONE MANURES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1405	Ivory Saw Dust.	B. B. Warner & Son, Plainville.	Manufacturer.	J. W. Hemingway, Plainville.
1404	Bone Dust.	Peter Cooper's Glue Factory, New York.	Gilbert Thompson, New York.	J. W. Hemingway, Plainville.
1354	Peter Cooper's Ground Bone.	Peter Cooper's Glue Factory, New York.	Manufacturer.	C. H. Cables, Thomaston.
1349	Rogers & Hubbard Co's Damp Bone Saw Dust.	Rogers & Hubbard Co., Middletown.	"	Station Agent.
1352	Rogers & Hubbard Co's Raw Knuckle Bone Extra Fine A.	Rogers & Hubbard Co., Middletown.	"	"
1361	Swift Sure Bone Meal.	M. S. Shoemaker & Co., Philadelphia.	F. Ellsworth, Hartford.	"
1351	Rogers & Hubbard Co's Raw Knuckle Bone Meal.	Rogers & Hubbard Co., Middletown.	Manufacturer.	"
1376	Americus Brand Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	E. M. Jennings, Southport.	George P. Jennings, Green's Farms.
1436	Pure Ground Bone.	Buffalo Fertilizer Works, Buffalo, New York.	J. E. Leonard, Jewett City.	Station Agent.
1375	Plumb & Winton's Pure Ground Bone.	Plumb & Winton, Bridgeport.	From stock purchased by T. B. Wakeman.	G. P. Jennings, Green's Farms.
1368	Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	E. M. Jennings, Green's Farms.	Austin Jennings, "
1402	Darling's Ground Bone.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	Station Agent.

BONE MANURES—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1363	Lister's Celebrated Ground Bone.	Lister Bros., Newark, N. J.	S. J. Hall, Meriden.	Station Agent.
1371	G. W. Miller's Ground Bone.	G. W. Miller, Middlefield.	Manufacturer.	W. W. Terrill, Middlefield.
1350	Rogers & Hubbard Co's Ground Bone, Fine A. X.	Rogers & Hubbard Co., Middletown.	"	Station Agent.
1431	Fine Ground Bone.	W. H. Anderson, Putnam.	"	"
1574	Americus Brand Pure Bone Meal.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1583	Preston & Son's Ground Bone.	H. Preston & Sons, Greenpoint, L. I.	Peck & Allen, Port Chester, N. Y.	Joshua Lyon, Greenwich.
1353	Peck Bro's Pure Ground Bone.	Peck Bros., Northfield.	Manufacturer.	C. H. Cables, Thomaston.
1417	Ground Bone, (Fine).	Lombard & Matthewson, Warrenville.	Durkee, Styles & Co., Willimantic.	Station Agent.
1360	Americus Brand Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	R. B. Bradley & Co., New Haven.	"
1398	Adams' Fine Ground Bone.	Adams & Thomas, Springfield, Mass.	A. W. Leighton & Co., New Haven.	"
1420	Preston's Ground Bone.	H. Preston & Sons, Greenpoint, L. I.	Brewster & Burnett, Norwich.	"
1377	Plumb & Winton's Bone Fertilizer.	Plumb & Winton, Bridgeport.	T. B. Wakeman.	G. P. Jennings, Green's Farms.
1525	Crescent Bone.	Lister Bros., Newark, N. J.	Swan's Seed Store, Bridgeport.	Station Agent.
1461	Ground Bone.	------------------------	------------------------	Harvey Elliot, North Guilford.
1560	P. W. Bennett's Ground Bone.	P. W. Bennett, Rockfall, Ct.	Manufacturer.	Manufacturer.
1564	G. H. Harris & Son's Pure Ground Bone.	G. H. Harris & Son, Eagleville, Ct.	"	"
1561	E. Smith's Bone.	E. Smith, South Canterbury, Ct.	"	"
1565	Wilkinson's Extra Fine Ground Bone.	Wilkinson & Co., 239 Center St., N. Y.	"	"

BONE MANURES.—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than				Coarser than	Cost per ton.	Valuation per ton.	Valuation exceeds cost.
				1/50 inch.	1/25 inch.	1/12 inch.	1/8 inch.	1/8 inch.			
1405	B. B. Warner & Son's Ivory Saw Dust	5.41	24.77	98	2	0	0	0	$30.00	$49.10	$19.10
1404	Peter Cooper's Bone Dust	1.41	30.99	34	12	34	20	0	31.20	37.13	5.93
1354	Peter Cooper's Ground Bone	1.62	31.70	40	15	24	21	0	23.75*	39.06	5.31
1349	Rogers & Hubbard Co's Damp Bone Saw Dust	2.35	15.67	97	3	0	0	0	25.00	27.19	2.19
1352	Rogers & Hubbard Co's Raw Knuckle Bone Extra Fine A	3.96	25.15	25	15	33	27	0	36.00	37.80	1.80
1361	Shoemaker & Co's Swift Sure Bone Meal	6.04	21.98	72	24	4	0	0	45.00	46.65	1.65
1351	Rogers & Hubbard Co's Raw Knuckle Bone Meal	3.96	24.57	32	33	35	0	0	38.00	39.58	1.58
1376	Williams, Clark & Co's Americus Brand Pure Bone Meal	3.93	20.10	51	19	28	2	0	35.00	35.36	.36
											Cost exceeds valuation.
1436	Buffalo Fertilizer Co's Pure Ground Bone	4.26	23.53	37	26	37	0	0	40.00	39.51	.49
1375	Plumb & Winton's Pure Ground Bone	3.32	22.88	41	16	17	14	12	35.00	34.35	.65
1368	Williams, Clark & Co's Pure Bone Meal	3.94	20.06	58	19	22	1	0	37.00	35.90	1.10
1402	Darling's Ground Bone	3.16	25.22	78	22	0	0	0	42.00	40.81	1.19
1363	Lister's Celebrated Ground Bone	3.61	13.72	30	15	27	28	0	27.00	25.16	1.84

* In New York.

BONE MANURES—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1868	Lister's Celebrated Ground Bone.	Lister Bros., Newark, N. J.	S. J. Hall, Meriden.	Station Agent.
1871	G. W. Miller's Ground Bone.	G. W. Miller, Middlefield.	Manufacturer.	W. W. Terrill, Middlefield.
1850	Rogers & Hubbard Co's Ground Bone, Fine A. X.	Rogers & Hubbard Co., Middletown.	"	Station Agent.
1481	Fine Ground Bone.	W. H. Anderson, Putnam.	"	"
1574	Americus Brand Pure Bone Meal.	Williams, Clark & Co., New York.	J. P. Little, Columbia.	J. P. Little, Columbia.
1588	Preston & Son's Ground Bone.	H. Preston & Sons, Greenpoint, L. I.	Peck & Allen, Port Chester, N. Y.	Joshua Lyon, Greenwich.
1858	Peck Bro's Pure Ground Bone.	Peck Bros., Northfield.	Manufacturer.	C. H. Cables, Thomaston.
1417	Ground Bone, (Fine).	Lombard & Matthewson, Warrenville.	Durkee, Styles & Co., Willimantic.	Station Agent.
1860	Americus Brand Pure Bone Meal.	Williams, Clark & Co., 101 Pearl St., New York.	R. B. Bradley & Co., New Haven.	"
1898	Adams' Fine Ground Bone.	Adams & Thomas, Springfield, Mass.	A. W. Leighton & Co., New Haven.	"
1420	Preston's Ground Bone.	H. Preston & Sons, Greenpoint, L. I.	Brewster & Burnett, Norwich.	"
1877	Plumb & Winton's Bone Fertilizer.	Plumb & Winton, Bridgeport.	T. B. Wakeman.	G. P. Jennings, Green's Farms.
1525	Crescent Bone.	Lister Bros., Newark, N. J.	Swan's Seed Store, Bridgeport.	Station Agent.
1461	Ground Bone.	-------------------------------	-------------------------------	Harvey Elliot, North Guilford.
1560	P. W. Bennett's Ground Bone.	P. W. Bennett, Rockfall, Ct.	Manufacturer.	Manufacturer.
1564	G. H. Harris & Son's Pure Ground Bone.	G. H. Harris & Son, Eagleville, Ct.	"	"
1561	E. Smith's Bone.	E. Smith, South Canterbury, Ct.	"	"
1565	Wilkinson's Extra Fine Ground Bone.	Wilkinson & Co., 239 Center St., N. Y.	"	"

BONE MANURES.—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than				Coarser than $\frac{1}{6}$ inch.	Cost per ton.	Valuation per ton.	Valuation exceeds cost.
				$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{6}$ inch.				
1405	B. B. Warner & Son's Ivory Saw Dust	5.41	24.77	98	2	0	0	0	$30.00	$49.10	$19.10
1404	Peter Cooper's Bone Dust	1.41	30.99	34	12	34	20	0	31.20	37.13	5.93
1354	Peter Cooper's Ground Bone	1.62	31.70	40	15	24	21	0	23.75*	39.06	5.31
1349	Rogers & Hubbard Co's Damp Bone Saw Dust	2.35	15.67	97	3	0	0	0	25.00	27.19	2.19
1352	Rogers & Hubbard Co's Raw Knuckle Bone Extra Fine A	3.96	25.15	25	15	33	27	0	36.00	37.80	1.80
1361	Shoemaker & Co's Swift Sure Bone Meal	6.04	21.98	72	24	4	0	0	45.00	46.65	1.65
1351	Rogers & Hubbard Co's Raw Knuckle Bone Meal	3.96	24.57	32	33	35	0	0	38.00	39.58	1.58
1376	Williams, Clark & Co's Americus Brand Pure Bone Meal	3.93	20.10	51	19	28	2	0	35.00	35.36	.36
											Cost exceeds valuation.
1436	Buffalo Fertilizer Co's Pure Ground Bone	4.26	23.53	37	26	37	0	0	40.00	39.51	.49
1375	Plumb & Winton's Pure Ground Bone	3.32	22.88	41	16	17	14	12	35.00	34.35	.65
1368	Williams, Clark & Co's Pure Bone Meal	3.94	20.06	58	19	22	1	0	37.00	35.90	1.10
1402	Darling's Ground Bone	3.16	25.22	78	22	0	0	0	42.00	40.81	1.19
1363	Lister's Celebrated Ground Bone	3.61	13.72	30	15	27	28	0	27.00	25.16	1.84

* In New York.

BONE MANURES—*Continued.*

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than				Coarser than. $\frac{1}{8}$ inch.	Cost per ton.	Valuation per ton.	Cost exceeds valuation.
				$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{8}$ inch.				
1371	G. W. Miller's Ground Bone	3.90	21.34	10	13	41	35	1	$34.00	$32.10	$1.90
1350	Rogers & Hubbard Co's Ground Bone, Fine AX	4.11	19.51	14	19	48	19	0	34.00	32.03	1.97
1481	W. H. Anderson's Fine Ground Bone	2.93	23.71	64	26	10	0	0	40.00	37.37	2.63
1574	Americus Pure Bone Meal	3.92	19.63	53	20	24	3	0	38.00	34.96	3.04
1588	Preston & Son's Ground Bone	4.39	11.77	45	20	16	9	10	30.00	26.42	3.58
1358	Peck Brothers' Pure Ground Bone	4.10	20.91	8	15	32	25	20	35.00	31.13	3.87
1417	Lombard & Mathewson's Ground Bone (fine)	4.12	19.93	38	18	23	21	0	38.00	34.10	3.90
1368	Williams Clark & Co's Americus Brand Pure Bone Meal,	3.63	20.27	45	21	25	9	0	38.00	33.97	4.03
1398	Adams' Fine Ground Bone	4.14	17.30	37	25	29	9	0	36.00	31.95	4.05
1420	Preston's Ground Bone	4.25	13.29	50	17	16	9	8	32.00	27.95	4.05
1377	Plumb & Winton's Bone Fertilizer	3.78	19.61	26	13	18	17	26	35 00	30.05	4.95
1525	Lister Bros.' Crescent Bone	3.55	12.64	44	19	21	15	1	30.00	25.00	5.00
1461	Ground Bone	3.99	21.61	2	2	7	11	78	......	26.75	
1560	P. W. Bennett's Ground Bone	3.60	24.05	5	9	29	47	10	32.00	32.23	
1564	G. H. Harris & Son's Pure Ground Bone	4.48	20.04	3	10	23	49	15	......	30.18	
1561	E. Smith's Bone	4.14	21.18	33	28	25	14	0	34.00	35.78	
1565	Wilkinson's Extra Fine Ground Bone	3.69	23.35	32	31	34	3	0	42.00	37.23	

BONE AND POTASH.

The samples whose analyses are given below, contain some potash.

They are valued in the same way as other bone manures with allowance of 4½ cents per pound for the potash.

1433. E. F. Coe's ground bone, from stock of J. A. Paine, Danielsonville.

1577. E. F. Coe's ground bone, from stock of J. P. Little, Columbia. Sampled by the dealer.

1507. Bone and Potash, made by Williams, Clark & Co., N. Y. Stock of J. F. Silliman, New Canaan.

ANALYSES AND VALUATIONS.

Mechanical Analyses.

	1433.	1577.	1507.
Finer than 1/50 inch	64	64	58
" " 1/25 "	16	19	15
" " 1/12 "	12	13	20
" " 1/6 "	8	4	6
Coarser " 1/6 "	0	0	1
	100	100	100

Chemical Analyses.

	1433.	1577.	1507.
Nitrogen	2.63	4.09	1.65
Phosphoric Acid	15.42	11.43	8.40
Potash	2.05	3.01	4.90
Cost per ton	$38.00	$35.00	$34.00
Valuation	26.30	29.42	19.48

DRY GROUND FISH.

Five samples of this article have been analyzed. The analyses follow.

1451. Preston's Fish Guano is not Dry Ground Fish in the ordinary meaning of the term, but is tabulated here for convenience.

The average cost of 4 samples of dry fish is $38.50, the average valuation $40.33, showing substantial agreement between actual cost and Station valuation.

DRY GROUND FISH.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1501	Williams, Clark & Co., Dry Ground Fish.	Williams, Clark & Co., New York, N. Y.	W. C. Reynolds, East Haddam.	Station Agent.
1359	Quinnipiac Dry Ground Fish.	Quinnipiac Fertilizer Co., New London.	R. B. Bradley & Co., New Haven.	Station Agent.
1479	Bowker's Dry Fish.	Bowker Fertilizer Co., 43 Chatham St. Boston.	Coburn & Gale, Hartford.	W. F. Andross, East Hartford.
1425	Stearns' Fish Guano.	Stearns & Co., New York, N. Y.	J. E. Leonard, Jewett City.	Station Agent.
1587	Wilcox Dry Fish Guano.	L. Wilcox & Co., Mystic Bridge.	Manufacturer.	Manufacturer.
1451	Preston's Fish Guano.	H. Preston & Son, Greenpoint, L. I.	Smith & Sons, West Cornwall.	Station Agent.

DRY GROUND FISH—ANALYSES AND VALUATIONS.

Station No.	Name or Brand.	Nitrogen.		Phosphoric Acid.							Cost per Ton.	Valuation per Ton.	Valuation exceeds Cost.
									Available.				
		Found.	Guaranteed.	Soluble in Water.	Reverted	Insoluble.	Phos. Acid Found.	Phos. Acid Guaranteed.	Found.	Guaranteed.			
1501	Williams, Clark & Co's Ground Fish	8.68	....	1.02	4.12	1.23	6.37	....	5.14	....	$38.00	$40.66	$2.66
1359	Quinnipiac Dry Ground Fish	8.67	*7.00*	.77	2.46	3.51	6.74	*6.00*	3.23	*4.00*	38.00	40.18	2.18
1479	Bowker's Dry Fish	8.05	*8.00*	.93	4.44	2.17	7.54	*7.00*	5.37	....	38.00	39.49	1.49
1425	Stearns' Fish Guano	8.70	*7.80*	.93	3.89	2.00	6.82	*6.90*	4.82	....	40.00	41.01	1.01
1587	Wilcox Dry Fish Guano	8.41	*8.64*	.60	5.59	1.01	7.20	....	6.19	....	.....	41.10	
													Cost exceeds Val'n.
1451	Preston's Fish Guano	3.91	*3.50*	2.42	2.55	.84	5.81	*5.00*	4.97	....	37.50	23.19	4 31

DRIED BLOOD.

1467. Dried Blood. Sold by Williams, Clark & Co., 101 Pearl street, New York. Stock of E. S. Roberts, East Canaan.

ANALYSIS.

Nitrogen	11.67
Cost per ton	$40.00
Nitrogen costs per pound	17.1 cts.

BONE AND BLOOD.

1529. Bone and Blood. Sold by Sperry & Barnes, New Haven. Stock of Sperry & Barnes. Sampled and sent by J. J. Webb, Hamden.

ANALYSIS.

Nitrogen	7.14
Phosphoric acid	7.39
Valuation per ton	$34.57

TANKAGE.

1463. A mixture of peat and offal. Made by F. S. Andrew & Co., New Haven. Sampled and sent by W. T. Andrew, Tyler City.

ANALYSIS.

Nitrogen	4.02
Phosphoric acid	4.83
Cost per ton	$20.00
Valuation	$20.67

BUFFALO HORN SAW DUST.

1403. Buffalo horn saw dust. Made by B. B. Warren & Son, Plainville. Sampled and sent by J. W. Heminway, Plainville.

Nitrogen	14.85
Phosphoric acid	.08
Cost per ton	$30.00
Nitrogen costs per pound	10.1 cents.

NITRATE OF SODA.

1515. Nitrate of soda. Mapes Formula and Peruvian Guano Co., New York. From stock of Wilson & Burr, Middletown. Sample drawn by Station agent.

ANALYSIS.

Nitrogen	16.13
Equivalent nitrate of soda	97.90
Cost per ton	$52.50
Nitrogen costs per pound	16.2 cents.

SULPHATE OF AMMONIA.

1379 and **1527.** Sulphate of Ammonia, made by E. H. Wardwell, No. 10 Warren street, New York, from stock purchased by J. J. Webb, Hamden.

1379. Sampled by J. J. Webb. **1527** by Station Agent.

1522. Sulphate of Ammonia, sampled by Station Agent from stock of Mapes Branch, Hartford.

ANALYSES.

	1379	1527	1522
Nitrogen	20.76	20.65	20.57
Equivalent ammonia	25.21	25.07	24.90
Cost per ton	$66.80*		76.00
Nitrogen costs per pound	16.1 cents.		18.4 cents.

POTASH SALTS.

1438. Muriate of Potash, stock of H. J. Baker & Bro., sampled and sent by Dennis Fenn, Milford.

1526. Muriate of Potash, 83.7 per cent., sold by H. J. Baker & Bro., New York, sampled by Station agent from stock purchased by J. J. Webb, Hamden.

1378. Muriate of Potash, 83.5 per cent., stock purchased of H. J. Baker & Bro., New York, by J. J. Webb, Hamden.

1374. Muriate of Potash, 70 per cent., sold by H. J. Baker & Bro., from stock of R. B. Bradley & Co., New Haven, sampled and sent by C. P. Augur, Whitneyville.

1520. Muriate of Potash, stock of G. B. Forrester, New York, sampled and sent by S. B. Wakeman, Saugatuck.

1521. Muriate of Potash, stock of G. B. Forrester, New York, sampled and sent by W. H. Couch, Saugatuck.

1499. Muriate of Potash, sold by Mapes F. & P. G. Co., New York, stock of Wilson & Burr, Middletown, sampled by Station Agent.

1466. Double Sulphate of Potash and Magnesia, Quinnipiac Fertilizer Co., New London, sampled by Station Agent, from stock of E. S. Roberts, East Canaan.

ANALYSES OF POTASH SALTS.

	1438	1526	1378	1374	1520	1521	1499	1466
Potash found	50.66	51.23	51.82	42.06	53.43	52.65	50.84	26.62
Equivalent muriate	80.2	81.1	82.1	66.6	84.6	83.4	80.5	
Cost per ton	$44.50	41.85	40.30	38.00	44.00†	44.00*	42.50	35.00
Potash costs per lb.	4.4 cts.	4.1 cts.	3.9 cts.	4.5 cts.	4.1 cts.	4.2 cts.	4.2 cts.	6.6 cts.

* In New Haven. † $42.50 in New York.

COTTON HULL ASHES.

1407. Cotton Hull Ashes purchased by F. Ellsworth, Hartford, sampled and sent April 20, by H. S. Frye, Poquonock.

1408. Cotton Hull Ashes purchased by F. Ellsworth, sampled and sent by H. W. Alford, Poquonock.

1441. Cotton Hull Ashes sampled and sent by Olds & Whipple, Hartford. The sample was taken from a car load which had been thoroughly worked over and mixed.

1476. Cotton Hull Ashes sampled and sent by J. M. Brown, Poquonock, from stock of R. E. Pinney, Suffield.

1482. Potash and Phosphoric Acid sampled and sent by John Mason, Warehouse Point, from stock bought of R. E. Pinney, Suffield.

1344. Cotton Hull Ashes sampled and sent by H. S. Frye, Poquonock.

1505. "Lime and Potash Mixture" sent by D. G. Sperry, Windsor Hill.

COTTON HULL ASHES—ANALYSES AND VALUATIONS.

	1407	**1408**	**1441**	**1476**	**1482**	**1344**	**1505**
Soluble phosphoric acid	1.19	1.92	2.27	2.02	.40	8.81	.47
Reverted phosphoric acid	5.06	4.61	7.69	8.06	5.60		7.99
Insoluble phosphoric acid	1.53	1.33	1.17	1.42	.36		.44
Potash soluble in water	24.82	28.74	24.53	13.14	22.28	19.51	21.36
Insoluble in acid	19.32	14.51					
Cost per ton	$35.00	35.00	35.00	39.00	39.00	39.00	
Valuation per ton	$46.48	53.04	52.43	44.85	42.13	42.38	44.78

1343 is a sample of the clinker from furnaces in which cotton hulls are burned.

It contains:

Sand and silicates undecomposed by hydrochloric acid	39.32
Phosphoric acid soluble in ammonium citrate	5.45
" " insoluble " "	3.61
Potash soluble in water	9.20
" insoluble "	8.00

It is questionable whether it would pay to transport this material to the north, although it would be an excellent source of potash for farmers near the place where it is produced.

Cotton hull ashes vary considerably in composition, those which are lightest in color being usually richest in potash. They are at present by far the cheapest source of potash in our market and are specially prized by tobacco growers. The supply is however limited.

Tobacco Stems and Tobacco Dust.

1486. A sample of Tobacco Stems believed to be somewhat damaged.

1346. Tobacco Dust from the factory of A. Wassermann, New York, sent by J. S. Kirkham, Newington. We are informed that this material, which is a uniform and quite fine powder, is the siftings from tobacco "clippings." It costs 40 cents per 100 lbs. The analyses follow:

	1486	1346
Moisture	46.70	9.64
Organic and volatile matters (by difference)	43.26	44.68
(Containing nitrogen	1.62	2.42)
Sand and soil	.49	32.28
Oxide of iron and alumina	.01	2.35
Lime	1.85	4.15
Magnesia	.45	1.62
Potash	6.26	2.82
Soda	.10	.59
Sulphuric acid	.33	.79
Phosphoric acid	.41	.52
Chlorine	.14	.56
	100.00	100.00
Cost per ton	$14.50	$8.00

Valuing nitrogen at 18 cents per pound, phosphoric acid at 6 cents, the potash which will combine with the chlorine present at 4½, and the excess of potash at 7¼ cents, the valuation of the tobacco stems is $15.28, of the tobacco dust $12.98 per ton.

1355. Spent Chloride of Lime. "Refuse from bleaching in knitting mills." Sent by James N. Bishop of Plainville. The material was a pasty mass which had the following composition:

Sand	1.34
Lime	23.48
Magnesia	0.38
Sulphuric acid	0.91
Chlorine as hypochlorite	1.65
Chlorine as calcium chloride	3.61
Water and matters undetermined	68.63
	100.00

The 1.65 per cent. of chlorine as hypochlorite corresponds to about 3 per cent. of calcium hypochlorite, which is the essential constituent of bleaching powder or so-called "Chloride of Lime."

The remaining 3.61 per cent. of chlorine corresponds to 9.7 per cent. of calcium chloride. There are then, 12.7 per cent. of lime salts present which are highly soluble in water, and unless greatly diluted, injurious. The hypochlorite is extremely corrosive and poisonous to vegetation. The calcium chloride if diluted with near one thousand times its weight of water would not be harmful and might be beneficial, but in a concentrated state would damage plants and injure the soil. It would not be wise to apply this lime to land or muck except in a small way as an experiment. Small quantities of this spent "Chloride of Lime" might perhaps be advantageously used in composting muck. The vegetable matter would neutralize or destroy the hypochlorite, but careful trials would be necessary to establish its value. If spread out thinly on land before plowing, especially on sod in the fall, it might be very useful for the lime it contains.

1516. Mud from a salt creek.
1517. Marine Mud.
1518. "Sea Lettuce."

The three last samples were sent for analysis by Borstelmann and Lobdell, Bridgeport.

ANALYSES.

	1516	1517	1518
Water	72.98	69.18	72.19
Organic and volatile matter†	9.69	17.08	12.91
Ash*	17.33	13.74	14.90
	100.00	100.00	100.00
Containing nitrogen†	.35	.47	.36
Containing phosphoric acid*	.06	.13	.07
Potash	.16	.14	.53
Sand	11.80	7.46	8.19

SWAMP MUCK.

1581. A sample of Swamp Muck dug in 1883 and allowed to lie for two years on hard ground. The sample was taken from the middle of the heap.

ANALYSIS.

Water	28.78
Organic and volatile matters*	22.96
Ash	48.26
	100.00
With nitrogen*	.61

The ash contains:

ANALYSIS.

Sand and soil	43.43
Oxide of iron and alumina	2.55
Lime	.41
Magnesia	.39
Phosphoric acid	.13

The dry muck contains:

Organic and volatile matter	32.23
Nitrogen	.86
Sand and soil	60.99
Oxide of iron and alumina	3.59
Lime	.59

REVIEW OF THE FERTILIZER MARKET.

NITROGEN.

Nitrogen of organic matter.

In Dried Blood at wholesale, nitrogen was quoted in the New York market at 12 cents per pound in December, 1884. It rose to 13.4 cents in March and 14.3 cents in May, which was the highest figure for the year. It fell to 13.6 cents in July, rallied slightly in August, fell again in September to 13.4 cents and rose again to 13.9 cents in November. The average wholesale quotation for the year has been 13.4 cents; for the last 6 months 13.7.

In Azotin at wholesale,* nitrogen was quoted at 12.8 cents per pound in December, 1884, it rose to 13.7 cents in March and has remained at about that ever since. The average price for the year and also for the last six months has been not far from 13.6 cents per pound.

In *Dry Ground Fish at wholesale,* nitrogen was quoted in New York at $30.25 per ton in December, 1884. It fell to $29.00 in January of this year and to $27.50 in April. In May it was quoted at $29.00 and has remained there ever since.

Dry ground fish has averaged this year, according to 9 analyses made in Massachusetts, New Jersey and this State, 8.6 per cent. of nitrogen and 6.9 per cent. of phosphoric acid. Now if we take 4.8 cents per pound as the wholesale cost of phosphoric acid in fish (6 cents the retail price less 20 per cent.), we may reckon *approximately* the wholesale cost of nitrogen in dry fish which will be, at $27.50 per ton of dry fish, 12.2 cents; at $29.00 per ton of dry fish 13.0 cents.

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* Azotin and Ammonite are trade names for animal matter (meat scrap, cracklings) very dry and free from grease.

The retail cost of organic nitrogen per pound at New York and Philadelphia factories during the last season has been about as follows :*—

In dried blood, 3 samples,	15.5 cents.
In dried fish, 3 samples,	14.8 "
In ammonite and tankage, 5 samples,	16.1 "

Retail Connecticut prices have been

Dried blood, 1 sample,	17.1
Dry fish, 5 samples	17.8

Nitrogen of Ammonia Salts.

At wholesale in New York, the nitrogen of sulphate of ammonia was quoted at about 15.4 cents per pound, from December, 1884, till July of this year. It fell to 14.9 cents in September where it still remains.

The average retail price of nitrogen in the same goods at New York and Philadelphia factories during the year (average of 8 analyses) has been† 16.7 cents per pound.

In Connecticut it has been sold at 16.1 and 18.4 cents per pound.

Nitrogen of Nitrate of Soda.

At wholesale in New York nitrogen in nitrate of soda was quoted at 14.4 cents per pound in December, 1884. It fell to 13.2 cents in April, rose again suddenly to 14.8 cents in August, 15.4 in September, 16 in October, while the average quotations for November were about 15.4 cents.

The average retail price of nitrogen in the same goods has been 16.7 cents per pound.‡

It has been sold in Connecticut at retail for 16.2 cents per pound.

The production of nitrate of soda is now controlled by a syndicate established in June, 1884, which aims to put on the market only enough to meet the demand and maintain steady, remunerative prices.

The syndicate has not yet fully realized the purpose for which it was formed because the stocks on hand when it was organized were very large, and moreover the state of the beet sugar market in Europe discouraged production of beets, lessened demand for nitrate of soda and so made the production of the nitrate for 1885 which had been determined on by the producers (ten million quintals), excessive.

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* Bull. N. J. Ag'l Exp't St., xxxv, p. 9.

† Bull. N. J. Ag'l Exp't St., xxxv, p. 8.

‡ Bull. N. J. Ag'l Exp't St., xxxv, p. 8.

During the first six months of 1885, nitrate of soda was sold in New York below London prices, and at times below cost of importation.

"Since 1870 with the exception of 1884, nitrate of soda was never so low as at present.

But at the same time the conditions are more favorable to a higher range of values, or at least the disturbing elements which have induced wide and violent fluctuations are absent, the production now being limited to the consumptive requirements of the world."—*New York Oil, Paint and Drug Reporter*, Jan. 6, 1886.

PHOSPHATIC MATERIALS.

Refuse Bone Black, which was quoted at $16.50 per ton in December, 1884, rose to $17.50 in April and is still quoted at that figure.

Ground Bone previously quoted at $29.00 per ton rose to $29.50 in May last and still remains at that figure.

Charleston Rock, f. o. b. in New York, was quoted at $8.75 per ton till September when it fell somewhat and is now quoted at $8.25.

Sulphuric Acid, 60°, quoted at 1.19 cents per pound in December, 1884, fell to 1.00 in April, rose again in October and was quoted at 1.05 cents per pound in November.

The above are wholesale quotations of the crude materials from which superphosphates are made. If we assume that soluble, reverted and insoluble phosphoric acid have *commercial* values (to be distinguished from agricultural values) which stand in the ratio of 9, 8 and 2, then the retail cost per pound of phosphoric acid in plain superphosphates bought direct of New York and Philadelphia manufacturers, as shown in analyses reported by the New Jersey Station* has been as follows:—

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* Bulletin xxxv.

	Soluble.	Reverted.	Insoluble.
In Superphosphates from Bone Black, Bone Ash, etc.	7.8 cents.	6.9 cents.	1.7 cents.
In Superphosphates from So. Carolina and other mineral phosphates	8.6 "	7.6 "	1.9 "

In the four samples of plain superphosphates whose analyses have been given in this Report, the average costs of soluble reverted and insoluble phosphoric acid have been 8.4, 7.4, and 1.8 cents per pound respectively.

ACTUAL POTASH.

In Muriate of Potash.

Potash at wholesale in New York was quoted at 3.3 cents per pound in December, 1884. It rose in March to 3.6 cents, fell again in June to 3.36 and has averaged about that ever since, being quoted at 3.38 cents per pound in November.

At retail in New York and Philadelphia, potash in high grade muriate has cost about 4.13 cents per pound.

The Connecticut retail price has been from 3.9 and to 4.4 cents per pound.

In Kainit.

Kainit at wholesale in New York was quoted at $6.76 per ton in December, 1884. It rose steadily till April to $9.25. Again it fell and was quoted at $6.85 in July. Since then it has risen to $7.40 in November.

Kainit varies considerably in composition. Assuming 12.2 per cent. of potash as its actual content the above quotations may be expressed in cost of actual potash as follows:—

At wholesale in New York, actual potash in Kainit cost .82 cents per pound in December, 1884. It rose steadily till April, when it was quoted at 3.8 cents. Again it fell to 2.8 cents in July. Since then it has risen to 3 cents in November.

At retail in New York and Philadelphia it has cost about 4.5 cents per pound.

NEW GRADES OF POTASH SALTS.

There are two new grades of potash salts that have recently come into market, which deserve special attention from those who intend to purchase this class of fertilizers for use in the Spring.

One is "95 to 98 per cent. Muriate of Potash," a purer form of muriate than the 80 per cent. The other is "96 to 98 per cent. Sulphate of Potash," which was sold *at wholesale in New York* in November last at 2¼ cents per pound or about 4.4 cents per pound of actual potash.

This would make the retail cost of potash in the form of sulphate not far from 5.3 cents per pound instead of 7½ cents which has been its valuation in double sulphate of potash and magnesia during the last year.

To recapitulate:

The fertilizer market, as far as we have been able to learn, has been subject to the usual temporary fluctuations, but there has been no considerable and permanent change in the market price of any of the standard raw materials from which mixed goods are made. The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged, and this average is taken as the quotation for the month.

The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

Phosphate rock, *kainit*, *bone*, *fish scrap*, *tankage*, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by an analysis at the time of purchase.

Sulphate of ammonia, *nitrate of soda and muriate of potash* are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, *azotin and ammonite* are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen multiply the per cent. of ammonia by the decimal .824. A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of dried blood has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $2.25 per unit, a ton of it will cost 8½×2.25=19.13.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given:

Ammonia at	$4.00	per unit	is equivalent to	nitrogen at	24.3	cts.	per lb.
"	3.90	"	"	"	23.7	"	"
"	3.80	"	"	"	23.0	"	"
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.2	"	"
"	2.90	"	"	"	17.6	"	"
"	2.80	"	"	"	17.0	"	"
"	2.70	"	"	"	16.4	"	"
"	2.60	"	"	"	15.8	"	"
"	2.50	"	"	"	15.2	"	"
"	2.40	"	"	"	14.6	"	"
"	2.30	"	"	"	14.0	"	"
"	2.20	"	"	"	13.4	"	"
"	2.10	"	"	"	12.8	"	"
"	2.00	"	"	"	12.2	"	"

Commercial sulphate of ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	5	cents per lb.	Nitrogen	costs	24.4	cents per lb.
"	4⅞	"	"	"	23.7	"
"	4¾	"	"	"	23.1	"
"	4⅝	"	"	"	22.5	"
"	4½	"	"	"	21.9	"
"	4⅜	"	"	"	21.3	"
"	4¼	"	"	"	20.7	"
"	4⅛	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	3⅞	"	"	"	18.9	"
"	3¾	"	"	"	18.3	"
"	3⅝	"	"	"	17.6	"
"	3½	"	"	"	17.0	"
"	3⅜	"	"	"	16.4	"
"	3¼	"	"	"	15.8	"
"	3⅛	"	"	"	15.2	"
"	3	"	"	"	14.6	"

Commercial nitrate of soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	3⅝	cents per lb.	Nitrogen costs	23.2	cents per lb.
"	3½	"	" "	22.3	"
"	3⅜	"	" "	21.5	"
"	3¼	"	" "	20.8	"
"	3⅛	"	" "	19.9	"
"	3	"	" "	19.2	"
"	2⅞	"	" "	18.3	"
"	2¾	"	" "	17.6	"
"	2⅝	"	" "	16.9	"
"	2½	"	" "	16.0	"
"	2⅜	"	" "	15.2	"
"	2¼	"	" "	14.4	"
"	2⅛	"	" "	13.6	"
"	2	"	" "	12.8	"

Commercial muriate of potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

If quoted at	2.00	cts. per lb.	Actual potash costs	3.96	cts. per lb.
"	1.95	"	" "	3.86	"
"	1.90	"	" "	3.76	"
"	1.85	"	" "	3.66	"
"	1.80	"	" "	3.56	"
"	1.75	"	" "	3.46	"
"	1.70	"	" "	3.36	"
"	1.65	"	" "	3.26	"
"	1.60	"	" "	3.16	"
"	1.55	"	" "	3.06	"
"	1.50	"	" "	2.96	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since May, 1882. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt.

		COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH. AT WHOLESALE IN
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1882.	May	19.1	19.7	18.3	22.7	3.26
	June	18.9	19.7	16.9	22.4	3.28
	July	19.8	19.5	16.8	22.4	3.40
	August	19.5	19.5	16.8	22.4	3.52
	September	19.7	20.3	17.7	22.4	3.60
	October	19.7	20.1	17.8	22.3	3.56
	November	19.7	20.0	17.6	22.2	3.56
	December	19.7	20.1	17.6	21.8	3.58
1883.	January	19.7	20.1	17.9	20.7	3.51
	February	19.4	19.7	17.9	21.9	3.42
	March	18.0	18.9	17.8	20.7	3.42
	April	18.2	18.9	17.9	20.1	3.40
	May	18.2	18.9	16.3	20.1	3.34
	June	17.8	18.9	16.3	20.0	3.36
	July	17.2	18.9	15.6	19.0	3.23
	August	16.0	18.9	15.3	18.6	3.18
	September	15.3	17.0	14.8	17.6	3.21
	October	15.0	15.2	14.8	17.3	3.12
	November	14.5	15.2	15.2	16.4	3.20
	December	14.4	17.0	15.2	16.4	3.22
1884.	January	12.9	13.2	14.8	16.4	3.28
	February	13.2	13.7	14.3	15.0	3.23
	March	13.6	13.7	14.2	14.6	3.34
	April	13.6	13.6	14.0	14.6	3.38
	May	14.0	13.9	14.4	15.3	3.44
	June	13.9	13.5	13.8	14.6	3.36
	July	13.2	13.5	14.2	14.9	3.37
	August	13.6	13.3	14.3	14.7	3.36
	September	12.8	13.3	14.4	14.4	3.28
	October	12.9	13.2	14.3	14.8	3.38
	November	12.4	12.6	14.4	15.2	3.26
	December	12.1	12.8	14.4	15.2	3.32
1885.	January	12.3	13.0	14.1	15.2	3.32
	February	12.6	13.4	14.4	15.2	3.36
	March	13.4	13.7	13.2	15.2	3.58
	April	13.6	13.7	13.2	15.2	3.51
	May	14.3	13.7	14.1	15.2	3.54
	June	13.9	13.7	14.0	15.2	3.36
	July	13.6	13.6	14.0	15.0	3.31
	August	13.8	13.6	15.0	14.9	3.34
	September	13.4	13.5	15.6	14.8	3.36
	October	13.4	13.5	16.0	14.8	3.36
	November	13.8	13.5	15.6	14.8	3.38

ANSWERS TO CORRESPONDENTS.

How much Nitrogen, Phosphoric Acid and Potash are removed from an Acre of Land in an Average Corn Crop?

From an acre of land on the New Jersey State College Farm[*] under ordinary cultivation there were harvested in 1884,

3824 pounds of shelled corn.
4041 " dried stalks.
950 " cobs.

These contained the following percentages of nitrogen, phosphoric acid and potash.

	Nitrogen.	Phosphoric Acid.	Potash.
Shelled Corn	1.38	0.71	0.40
Stalks	0.65	0.37	0.82
Cobs	0.31	0.27	0.50

Therefore the total amount of these ingredients, calculated in pounds to the acre, is as follows :—

	Nitrogen. pounds.	Phosphoric Acid. pounds.	Potash. pounds.
In shelled corn	52.7	27.2	15.3
In dried stalks	26.3	16.0	33.1
In cobs	2.9	2.6	4.8
Total	81.9	44.8	53.4

What is the best Fertilizer?

"The question as to which is the most serviceable and best fertilizer is like the question, which is the best and most serviceable medicine—impossible to answer. All depends on the patient, on what ails him, and on how he is being treated otherwise.

"The Experiment Station might be compared to a sanitary engineer, but not to a practicing physician! We are unable to prescribe for land. The only way is for the practical farmer to make trials on his land with fertilizers or fertilizing chemicals which he knows are of good quantity and study the effects."

"I cannot advise you as to which is the best patented manure for potatoes and corn? Few, if any, of the Fertilizers sold in this State are patented. They all claim to be good and most of them are good. There is a choice among them in respect to cost which you can make by referring to the Station Reports.

"There is a choice also in respect to action on the crop. This will depend somewhat on the character of your soil and can only be learned by experience. One fertilizer will appear to be best one year or on some crops and land and another season owing to different weather, wet or drought, or on other land or plants, another kind of fertilizer will give the best result. I should try a fertilizer that would give me *a good percentage of nitrogen, soluble phosphoric acid and potash for the least money.*"

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[*] See Report N. J. Ag'l Exp't Station, 1884, 127.

"We can give no formula for an Onion Manure. The food which the onion requires is the same that all other crops require. If it requires any special proportions of fertilizing ingredients neither we or any one else can positively say what that is. Probably a fertilizer having about the composition of the "special" onion, potato, tobacco or corn manures would be as profitable a fertilizer as you could apply to the onion."

COTTON SEED MEAL.

A correspondent writes, "I wish you would tell me if there is much variation in the value of cotton seed meal for feeding purposes.

Do they make two kinds of cotton seed meal, one including the hull and the other not?

Does the cotton seed meal of your analyses Report of 1884 include the hull ground with the kernel?

I wish you would advise me which is preferable to fatten cattle and sheep: cotton seed meal or 'New Process' linseed meal."

It was replied:

"The best cotton seed meal is that which is ground from the 'decorticated seed.' It contains no hull and no cotton fibre. It has a nearly pure yellow color.

Damaged cotton seed meal, originally good but injured by wet and mould, or ground from damaged seeds often comes into the market at low rates, but is properly used as a fertilizer only.

Cotton seed meal made from the entire seed, after removal of cotton fibre as far as practicable, is another inferior grade and may be recognized by the dark particles of hull which it contains. A sample of this article analyzed here in 1881 (the cost of which was $30.00 per ton) contained 22.25 per cent. of protein while the best (decorticated) cotton seed meal contains about 42 per cent. of protein.

The comparative feeding values of the two sorts are, roughly speaking, in the ratio of their content of protein. The undecorticated meal contains but little more than half as much as the other and also contains the indigestible and therefore worse than useless hulls.

Cotton seed meal and new process linseed meal have the following average composition.

	Cotton seed meal 24 analyses.	New process linseed meal. 12 analyses.
Water	8.33	10.12
Ash	7.25	5.93
Protein	42.06	32.94
Fibre	5.69	9.09
Nitrogen-free extract	23.43	38.35
Fat	13.24	3.57
	100.00	100.00

You will notice that cotton seed contains some nine per cent. more protein and 9⅔ per cent. more fat than new process linseed meal. It therefore contains considerably more nutritive matter and if the selling price is the same is considerably cheaper.

The very concentrated nature of cotton seed meal, however, renders the more caution necessary in its use. Cattle can only stand small quantities of it without digestive disturbance."

It may be added that in England the undecorticated cake is preferred by some for feeding to the other kind, because as alleged it seldom if ever produces unfavorable symptoms in the cattle. This it has been claimed is due to astringent and medicinal properties in the hulls, but is very likely due to the fact that undecorticated cake is less concentrated and therefore is less likely to be fed in excessive amount. Cotton seed which is not *perfectly* sweet is entirely unfit for food. It is not unlikely that the albuminoids which make up about half of the dry substance of cotton seed meal when they begin to decompose on account of dampness, may give rise to poisonous alkaloids similar in nature to those formed from nitrogenous animal matter under like circumstances and like those developed in damaged maize to which in Italy the disease called *pellagra* has been attributed.

The Application of Potash Salts.

The following observations in regard to this subject freely translated from a book by Dr. Märcker of the Halle Experiment Station (Die Kalisalze und ihre Anwendung in der Landwirthschaft), are of value to the farmers of this State in view of the increasing use which is being made of this class of fertilizers.

After a careful review of recorded experiments on the matter Dr. Märcker concludes:

1. Failure in the use of potash salts is very often due to a lack of phosphoric acid and nitrogen in the soil.

2. A *direct* action of potash salts is only to be expected on such soils as are naturally deficient in potash, especially light porous soils.

3. Since by absorption in the soil all potash salts pass into combination with silica, it is of no consequence as far as supplying a deficiency of potash is concerned whether muriate or sulphate is used. Frequently therefore the cheapest form of potash is the best.

4. There is no reason to believe that the potash salts containing chlorine are injurious to vegetation: on the contrary the muriate is often to be preferred because its potash is more thoroughly diffused in the soil.

5. Potatoes and sugar beets form an exception since the starch or sugar production is decreased by muriates. Tobacco is also injured as to burning quality by the same.

The prejudice against magnesium chloride in potash salts is also unreasonable. In dilute solution it is no more hurtful than potassium or sodium chlorides.

6. The impure (low grade) potash salts have indirect effects as follows:

a. They act as solvents on the plant food held in the soil.

b. They keep the soil more moist.

c. They tend to make summer grain ripen earlier.

From his observations of the effect of potash salts on particular crops, we select the following:

Potatoes. In almost all cases potash salts have increased the yield, when used in connection with nitrogenous and phosphatic manures. In very few cases was the per cent. of starch in the potatoes increased, in many cases (12 out of 21) it was considerably diminished. The depression of starch was greatest when potash salts were applied nearest planting time. The muriates decreased the starch yield more than the sulphates especially when applied late. Low grade salts or the muriate if used, should therefore be applied as early as possible, at the latest in December, any excess which might do no harm on other crops should be avoided, and if the potash must be applied near planting time only sulphate should be used.

Fodder Beets. Here too the potash salts were generally only useful when phosphates and nitrogenous manure were used together with them. In some cases common salt was as effectual as potash salts, indicating that the indirect action of the salts was the most important.

Muriates gave better results than sulphates. A late application of potash salts containing much chlorine specially favored the development of leaves.

When muriates were applied late they increased the dry substance of the crop less than sulphates.

In general potash salts produce good effects on all crops if used rationally in connection with nitrogenous matter and phosphates.

With regard to the soils which are specially adapted for utilizing potash salts, Dr. Märcker says: "They work with absolute certainty on all moor lands. On light sandy soils their action is also tolerably certain when used in connection with nitrogen and phosphoric acid."

Necessary conditions for success in the use of potash salts are that there shall be no accumulation of free acid or of soluble iron salts in the soil nor of standing water in the subsoil. Standing water must be got rid of by drainage, iron salts and free acid by an application of lime.

Here follow certain rules for the use of muriate of potash issued by the Stassfurt Syndicate of Potash Manufacturers:

RULES FOR THE EMPLOYMENT OF MURIATE OF POTASH FOR MANURING PURPOSES.

The best time for manuring with muriate of potash depends chiefly on the quality of the soil. For heavy soils, manuring in autumn and winter is to be recommended; while for light and sandy soils, early spring is the most suitable time. For meadows, also moorland and all kinds of land liable to be flooded, manuring in spring is advisable.

The best method for employing muriate of potash for field and garden cultivation is to strew it by hand, broad cast, on the unplowed field or the rough furrow. A top dressing of manure is only recommended for meadows, clover and lucerne, but it must be done in early spring with care and if possible, during wet weather. To place the muriate near the seed in drills or hills is not advisable. When strewed by hand, it is recommended that the muriate of potash be mixed with an equal or double quantity of dry earth or peat-dust, also in distributing by sowing machines a previous mixing with other artificial manures such as superphosphate, guano, etc., is recommended. Deep and regular plowing is of great importance when the plants have to be hoed. For cultivating vines and fruits, it is advisable to make a solution of the salts and to mix the same with liquid manure (in spring).

The quantity required for potash manuring is, of course, dependent on the chemical condition of the soil and also the amount of potash the intended crop requires. However it may be taken as a general rule, that 1½ to 4½ cwts. of 80 per cent. muriate of potash for one acre are necessary and remunerative.

On Methods of Testing the Agricultural Value of Nitrogen in Mixed Fertilizers.

It is a fact of common farm experience that nitrogenous manures differ widely in their efficiency. Nitrate of soda for example often has a visible effect on grass land within ten days after sowing; dried blood requires a longer time to affect the color or growth of grass, while an application of leather or hair may never show the slightest effect. The nitrogen of nitrate of soda and of blood is said to be "available" while that of leather or hair is called "inert."

These terms are relative. Probably any form of nitrogen in the soil may to some extent and at some time become "available," as the potash contained in granite, or the phosphoric acid in apatite are gradually changed into soluble plant food. It is nevertheless justly demanded that the nitrogen of commercial fertilizers, which is their most costly ingredient, shall be in such a form that it is readily and completely assimilated by vegetation so that the value of the application may be largely realized in one season. Only such forms of nitrogen can be fairly called available.

A considerable number of manufacturing wastes, rich in nitrogen but differing greatly in their value as plant food, are now on the market and their use is urged upon manufacturers of mixed fertilizers. In general, such of these waste products as are agriculturally of least value are also least expensive, and therefore the temptation to use them in manufactured goods is to some very strong.

It is highly desirable to know in the first place how these nitrogenous wastes compare with each other and with some standard such as nitrate of soda in availability, and various experimenters have already accomplished something in this direction.* In the next place it is important either to be able to identify these various "ammoniates" in mixed fertilizers, or else to have some means of distinguishing in such fertilizers between available and inert nitrogen;—some measure of its availability. Unfortunately it has hitherto been difficult or impossible to identify with certainty most of the inferior ammoniates either by inspection or by ordinary chemical tests. The treatment with acid during the process of manufacture, the grinding and the mixture with phosphatic material and potash salts, so alters the structure and appearance that in many cases the microscope fails to identify anything and chemical tests are not generally applicable. A study of the solubility of the ammoniates in given reagents or the rapidity of their decomposition by fermentation under given conditions may lead to some practical method of determining the availability of nitrogen in mixed fertilizers.

It is believed that plants take their supply of nitrogen from the soil chiefly in the form of nitric acid and therefore organic nitrogenous matter must undergo decomposition and solution in the soil water before its nitrogen can be available. Such nitrogenous matters as are most readily soluble or most readily fermented in the soil will, other things being equal, be most available as fertilizers.

It is impossible to imitate exactly the solvent action of the soil water and the fermentation which takes place when a small amount of nitrogenous matter is mixed with large quantities of earth as in ordinary farm practice, but the relative solubility and rapidity of fermentation of these ammoniates can be tested under accurately controlled conditions and also their relative crop-producing power. Then if these two methods of examination give concordant results, the first named may be adopted as a test of the availability of nitrogen in mixed goods which from the nature of the case could not be tested by the method of field or pot experiment.

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* See Storer, Bulletin Bussey Institution, 1877, part I, 58, On the Fertilizing Power of Roasted Leather. Petermann, Centralblatt, Ag. Chem., 1881, 590, On the Agricultural Value of Leather Meal. Same Journal, 1882, 454, On the Agricultural Value of so-called "Dissolved Wool." Same Journal, 1883, 658, On the Agricultural Value of Dried Blood. Märcker, Centralblatt, Ag. Chem., 1883, 584, On the Value of Different Nitrogenous Compounds as Plant Food and their Influence on the Composition of Barley (Nitrate of Soda, Sulphate of Ammonia, Blood Meal, Horn Meal and Leather Meal).

Stutzer and Klinkenberg, Journal für Landwirthschaft, 1882, p. 363, proposed to digest nitrogenous fertilizers with an artificially prepared gastric juice and determine the solubility of the nitrogen in this reagent as a measure of its comparative solubility in the soil.

The results obtained by these investigators need not here be repeated in detail, since they have been republished recently in this country in an article by Drs. Shepard and Chazal of South

RESULTS OF DRS. SHEPARD AND CHAZAL.

Nitrogenous Organic Matters and Mixtures examined by Shepard and Chazal. DESCRIPTION.	Containing of total Nitrogen.	Of 100 Parts of Nitrogen contained in each substance	
		Were Dissolved Parts.	Were not Dissolved Parts.
	Per cent.		
1. Dried Blood (preëminently red)	15.19	99.81	0.19
2. Dried Blood (preëminently black)	14.49	78.61	21.39
3. Dried and ground fish-scraps after expression of oil	11.56	88.67	11.33
4. Dried animal matter from slaughter house	12.84	61.29	38.71
5. Dried Flesh (principally muscular)	14.17	93.32	6.68
6. Dried Limulus Polyphemus (King Crab), shell and all. Said to be abundant in supply	12.15	52.10	47.90
7. Acidulated Fish-scraps	7.14	84.59	15.41
8. Roasted Leather Meal	9.92	37.80	62.20
9. Cotton Seed (pressed and ground)	7.76	83.18	16.82
10. The above after extraction of remaining oil by bisulphide of carbon	8.56	85.67	14.33
11. Cotton Seed, simply ground, neither linted, pressed nor cleaned	4.23	83.10	16.90
12. Mixture. ⅓ Cotton Seed Meal, ⅓ Kainite and ⅓ English Acid Phosphate	2.66	88.35	11.65
13. Mixture, ⅓ Cotton Seed Meal, ⅓ Kainite and ⅓ Phosphate Dust (Floats)	2.78	79.14	20.86
14. Acid Phosphate ammoniated with leather meal and dried out with burnt marl*	1.70	30.25	69.75
15. Acid Phosphate ammoniated with No. 4, and dried out with burnt marl*	2.14	85.80	14.20
16. Mixture, Acid Phosphate, Kainite, Nitrate of Soda, Sulphate of Ammonia and No. 8	3.18	52.99	47.01
17. The same, except with No. 1, instead of No. 8	3.10	90.32	9.68
18. The same, except with No. 4, instead of either 8 or 1	2.74	74.50	25.50

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* In both of these cases the ammoniating matter was thoroughly soaked with acid before adding the phosphatic powder. The acid employed was of 50° B. strength.

Carolina on Available Nitrogen. In general the results showed good agreement with the results of field trials, in that the nitrogen of approved ammoniates, such as blood, raw and steamed bone and Peruvian guano, was quite soluble in gastric juice (from 88 to 98 per cent.) and the nitrogen of ammoniates known to be inferior, leather, horn and wool waste, was quite insoluble (2.7—40.7). The articles experimented with were blood meal, roasted leather meal and horn meal, horn shavings, poudrette, wool waste (actual wool), raw bone meal, steamed bone meal, and Peruvian guano. Drs. Shepard and Chazal, in the pamphlet referred to, have extended the investigation of Stutzer and Klinkenberg to other ammoniates such as are used in this country. The results are here given in full, with the explanations.

3. This sample of dried and ground fish-scraps was an exceedingly well prepared one.

4. This sample had been through the process of "rendering" with superheated steam, which may have removed some of the "available" nitrogen.

5. A very admirable preparation of dried meat-scraps.

6. The king crab was chopped into bits and then dried, shell and all. Although quite nitrogenous, it does not appear to be "available." Perhaps after the extraction of its oil, it might prove more so.

7. A sample of acidulated fish-scraps. Had this article been as well prepared as No. 3, the results might have proven better.

8. An excellent article, so far as preparation goes, and one capable of being used in the fertilizer trade without much fear of detection. The result agrees with that obtained by Stutzer and Klinkenberg.

9, 10. The extraction of the oil remaining in No. 9 increases relatively its content of nitrogen, as also its availability.

12, 13. The cotton seed in these mixtures affords about the same amount of available nitrogen as it does by itself, although that mixed with the acid phosphate yielded the best results of any.

14. It will be noted that this treatment of the leather meal did not improve its solubility.

15. Whereas the same treatment increased the availability of the dried animal matter.

16. The mixture was proportioned to contain about 2 per cent. of nitrogen from leather alone; and, throwing out of the calcu-

lation the rest of the nitrogen, it will be found that about 25 per cent. of the leather's nitrogen was dissolved. This result agrees with No. 14 rather than with No. 8.

17. Mixture calculated to contain about 2 per cent. of nitrogen from No. 1 (dried blood). Throwing aside the nitrogen due to the presence of nitrate of soda and sulphate of ammonia, it will be seen that 85 per cent. of the nitrogen due to the dried blood was dissolved.

18. Mixture calculated to contain about 2 per cent. of nitrogen from No. 4 (dried animal matter). Here 35 per cent. of the nitrogen in the dried animal matter failed to be dissolved, which agrees quite tolerably with result No. 4 (38.71 per cent.).

"Our conclusion, based on the preceding results, leads us to believe that this method may probably be developed into a useful adjunct in the examination of nitrogenous organic matters, and possibly in that of the ordinary commercial manures containing nitrogen. Already we believe that it is susceptible of improvement, and we do not doubt that it will experience material modification in the hands of those analytical chemists who may try it. To them we would commend it as a very interesting mode of investigation. Ultimately it may prove of value to the agricultural public."

At the time of publication these gentlemen hoped to continue this investigation, but as nothing has since been published by them and as the matter is of great importance to those who have the responsibility of official fertilizer examinations, this Station undertook last summer a further study of the subject.

The object was to compare under exactly the same conditions every kind of ammoniating material with which we were familiar in reference to the solubility of the nitrogen in pepsin solution, and so to learn whether the method would in all cases distinguish by their solubility ammoniates which were known to be agriculturally valuable from those which were believed to be agriculturally worthless and then to test the applicability of the method to mixed fertilizers.

The present paper is chiefly concerned with the examination of the different ammoniates by themselves.

The preparation of reagents and the details of the process are as follows:

Pepsin solution was made by dissolving 5 grams of Golden Scale Pepsin, made by the New York & Chicago Chemical Co., in 1000 c. c. of 0.2 per cent. hydrochloric acid and filtering the solution. A large amount of the dry, thoroughly mixed pepsin was kept on hand and the solution was made up only as required.

The Digestion.—Two grams of the nitrogenous material in a beaker of 300 c. c. capacity was treated with 200 c. c. of pepsin solution, and the beaker, covered with a watch-glass, was placed in a water bath kept at 40° C. This bath consisted of a galvanized iron box 8 inches deep, 16 inches long by 12 inches wide, standing on legs with a well-fitting cover perforated to admit a thermometer. Inside, five inches below the upper edge of the box was a diaphragm full of perforations on which the beakers stood and sufficient water was poured in to fill the bath about on a level with the solution in the beakers. This large amount of water in the bath made the regulation of temperature comparatively easy. After two hours digestion 0.1 per cent. of hydrochloric acid was added (2 c. c. of a 10 per cent. solution) with vigorous stirring. Every three hours this was repeated, so that at the end of 12 hours the total amount of hydrochloric acid present was six-tenths of one per cent. The heat was then removed and the solution allowed to cool in the bath. The next day the heating was continued for 12 hours, acid being added as before till one per cent. of acid was present. The solutions were then filtered on paper with the aid of the pump. The residues were washed with water and dried and nitrogen was determined, deduction being made when necessary for nitrogen in the filter paper.

The determination of nitrogen was in all cases made by Kjeldahl's method and thus was avoided all necessity for cutting the filter paper fine. All materials experimented on were ground so as to pass a $\frac{1}{60}$ in. sieve.

PRELIMINARY EXPERIMENTS.

Effect of acid without pepsin.

Hydrochloric acid has of itself a peptonizing action and experiments with wheat bran had shown that this acid alone dissolved very nearly as much nitrogenous matter as it did when pepsin was present.

To ascertain whether the same would hold true with the materials under examination, parallel experiments were made with ground leather and dried blood, using in one case acid alone, in the other pepsin solution.

	Of the total nitrogen were dissolved	
	by acid alone.	by pepsin solution.
From dried blood	17.7 per cent.	96.8 per cent.
From leather	14.5	25.4

The addition of pepsin is evidently necessary.

Effect of Salts.

Certain salts are known to hinder the solvent action of pepsin solution. It is proposed to remove all salts which are soluble in water, previous to the digestion, when they are present in considerable quantity; but calcium phosphate and to some extent calcium sulphate cannot be so removed. To decide whether their presence interfered seriously with the solution of nitrogen, digestions were made in the manner described, both with dried blood and with dry fish, adding in each case certain quantities of the salts named. The tri-calcium phosphate was a chemically pure article prepared by precipitation and therefore more easily soluble in dilute acid than ordinary rock phosphate. Calcium sulphate was in the form of fine ground land plaster. The results were as follows:

	Of the total nitrogen were dissolved.	
2 grams dried blood	98.1	per cent.
2 grams dried blood + 1 gram phosphate	96.9	"
2 grams dried blood + 2 grams phosphate	95.9	"
2 grams dried blood + 2 grams phosphate + 1 gram gypsum	94.8	"
2 grams dried blood + 2 grams phosphate + 2 grams gypsum	93.7	"
2 grams dried blood + 4 grams phosphate + 4 grams gypsum	75.3	"
2 grams dry fish	70.0	per cent.
2 grams dry fish + 1 gram phosphate	70.1	"
2 grams dry fish + 2 grams phosphate	67.1	"
2 grams dry fish + 2 grams phosphate + 1 gram gypsum	68.7	"
2 grams dry fish + 2 grams phosphate + 2 grams gypsum	62.4	"
2 grams dry fish + 4 grams phosphate + 4 grams gypsum	47.6	"

When present in large quantity these salts seriously interfere with the solution of nitrogen. In none of the ammoniates however is the ratio of organic to inorganic matter lower than 1 to 1, and in none is the inorganic matter so readily soluble and so liable in consequence to interfere as in these artificial mixtures of an ammoniate with salts. These results, as well as those of Shepard and Chazal, indicate that the presence of phosphate and sulphate of lime affects the solubility of nitrogen but not so seriously as to impair the usefulness of the method.

Effect on digestion of the added acid.

As digestion proceeds, hydrochloric acid combines with the albuminoids, and if the amount of nitrogenous matter present is large the quantity of free acid may be so much reduced that the process of digestion is arrested. To obviate this, free acid is added from time to time, but if the total quantity of free acid rises much above 0.2 per cent. digestion is likewise hindered or stopped. To study the effect of the added acid under the conditions of these experiments digestions were made with ground leather and with dried blood in the usual way, and other digestions were made as usual except that no acid was added besides that contained in the pepsin solution.

	Of the total nitrogen was made soluble.	
	0.8 pr. ct. acid added.	No acid added.
Dried blood	96.8 per cent.	93.8 per cent.
Leather	25.4	44.4

The 0.4 gram hydrochloric acid present in the pepsin solution was not enough to complete the digestion of dried blood.

Leather seems to be very slowly soluble in pepsin solution and the addition of acid checks its digestion, whereas without added acid the digestion will slowly continue till the experiment is closed.

The Time of Digestion.

A considerable number of comparative trials showed that while certain materials were as fully digested in 12 hours as in 24 hours, others were not, and therefore in the experiments hereafter described, the time of digestion was always 24 hours unless the contrary is stated.

SOLUBILITY OF AMMONIATES IN PEPSIN SOLUTION.

Here follows a description of the materials tested.

	Per cent. Nitrogen.
Blood No. 1. Kiln dried or black blood	13.44
Blood No. 2. Kiln dried or black blood. Probably of same origin as blood No. 1	13.47
Ammonite No. 1536. Sent by the committee on nitrogen of the Association of Official Chemists	12.85
Ammonite A, No. 1569. Made and sent by M. L. Shoemaker & Co., Phila.	12.73
Ammonite B, No. 1588. Made and sent by M. L. Shoemaker & Co. Both these samples are made from animal matter, beef and pork "cracklings," etc., from which all grease is removed by benzine	12.68
Fish No. 1598. This sample of menhaden was taken directly from a factory. It had been cooked as usual to extract the oil and had lain in the pile about a week. It was rapidly dried in the laboratory over oil of vitriol	10 64
Dry Ground Fish, No. 1439. This is the commercial article of good quality	8.76
Dried Horse Meat, not acidulated. The commercial article from a New York dealer	8.12
Ground Bone No. 1197. An exceptionally clean, hard raw bone from button factory	4.11
Cotton Seed Meal, No. 1532, decorticated	6.68
Castor Pomace, No. 4	6.88

	Per cent. Nitrogen.
Maize Refuse from starch extraction	5.55
Cave Guano from the Caribbean Sea	5.41
Buffalo Horn Saw Dust, No. 1403	14.85
Horn Shavings, a manufacturing waste	15.37
Fine Ground Horn and Hoof, No. 1567	13.69
Wool Waste, No. 1537. It appears to be sweepings or the refuse dustings of wool. It has apparently very little oil in it	11.25
Felt Waste, a loosely woven material	13.12
Leather, No. 3. A sample received some years ago of material then offered in market. It was fine and brittle, but the method of preparation is not known	8.13
Leather treated by the benzine process, No. 1568.	8.40
Leather reduced by superheated steam, dried and ground in a disintegrator	6.85
"Prepared Ammonite." An article sold at a low price and said to be quite extensively used in centers of fertilizer manufacture	8.06
Hair and Leather, another ammoniate which is being pushed into market and thought to be quite extensively used	6.91

In the following table are given the results of digestion with the reagents and in the manner above described.

Material.	Per cent. of Nitrogen.				Of the total nitrogen were dissolved, per cent.
	Total.	Insoluble in pepsin solution (Duplicate trials).		Insoluble. (Average).	
Blood No. 1	13.44	.52	.34	.43	96.8
Blood No. 2	13.47	.25	.29	.27	97.9
Ammonite No. 1536	12.85	2.69	2.77	2.73	78.7
Ammonite A*	12.73	1.82	1.91	1.87	85.4
Ammonite B*	12.68	2.91	2.81	2.86	77.5
Fish No. 1598	10.64	1.31	1.17	1.24	85.9
Dry Ground Fish No. 1439	8.76	2.54	2.53	2.53	71.2
Dried Horse Meat	8.12	3.35	2.93	3.14	61.3
Bone No. 1197	4.11	.04	.06	.05	98.8
Cotton Seed Meal No. 1532	6.68	.47	.52	.49	92.7
Castor Pomace No. 4	6.88	.52		.52	92 4
Maize Refuse	5.55	1.00	.91	.95	82.9
Cave Guano	5.41	5.05	4.91	4.98	7.9
Buffalo Horn Dust No. 1403	14.85	13.24 13.80	14.32		7.2
Horn Shavings	15.37	12.57	12.55	12.56	22.4
Fine Ground Horn and Hoof No. 1567*	13.69	9.78	9.89	9.83	28.2
Wool Waste No. 1537	11.25	11.17	10.24	10.71	4.8
Felt Waste	13.12	12.15	12.33	12.24	7.2
Leather No. 3	8.13	6.03	6.10	6.06	25.4
Leather by benzine process, No. 1568	8 40	5.25	4.98	5.38	35.9
Leather by superheated steam	6.85	5.13	5.15	5.14	33.3
Prepared Ammonite	8.06	5.25	5.24	5.24	34.9
Hair and Leather	6.91	5.93	6.00	5.96	13.8

* 12 hours digestion.

The sample of Dry Ground Fish No. 1439, is the least soluble of all of the better class of ammoniates. In order to see if this was exceptional, all the samples of dry ground fish which have been received this year were tested.

The results are given in tabular form.

Station No.	Time of Digestion, hours.	Per cent. of Nitrogen.				Of the total nitrogen were dissolved, per cent.
		Total.	Insoluble in pepsin solution (Duplicate trials).		Insoluble. (Average).	
1439	12	8.76	2.54	2.23	2.38	72.8
1425	12	8.78	2.93	3.09	3.01	65.7
	24		2.61		2.61	70.0
	36		2.34		2.34	73.3
1451	12	4.01	1.47	1.50	1.48	63.1
	24		1.22		1.22	69.6
	36		1.13		1.13	70.0
1359	12	8.71	3.43		3.43	60.6
	24		2.86		2.86	67.2
	36		2.66		2.66	69.6
1424	12	8.68	3.61	3.79	3.70	57.4
1501	12	8.72	3.75	3.79	3.77	56.7
	24		3.07		3.07	64.8
	36		2.86		2.86	67.2
1479	12	8.11	3.70		3.70	54.3
	24		3.11		3.11	61.6
	36		2.91		2.91	64.1
1587	12	8.80	4.18	4.27	4.23	51.9
	24		3.72		3.72	57.7
	36		3.36		3.36	61.9

The solubility of nitrogen in all these samples was considerably less than had been observed in other ammoniates of the better class. Experiments were made to ascertain, if possible, the reason of this.

Effect of Oil.

Fish always contains a considerable amount of oil which may partly envelope the nitrogenous matter, and hinder or prevent perfect contact with the pepsin solution. It is also possible that by exposure to air a portion of the oil may be converted into a substance similar to linoxyn which would offer even more resistance to the action of solvents. Linoxyn as described by Mulder (Die Chemie der austrockenenden Oele, p. 98) is heavier than water, amorphous, elastic, *insoluble in water*, *alcohol and ether*, as well as in *dilute mineral acids.* It swells in chloroform or carbon bisulphide and finally dissolves. The best solvent is said to be a mixture of chloroform and alcohol.

Fish No. 1439 dried and extracted continuously with absolute ether for six hours yielded 13.61 per cent. of extract. The residue extracted with chloroform gave 3.09 per cent. of a dark brown, nearly black substance, scarcely fluid even at 100° C., which had a strong fish odor.

Seven grams of fish No. 1479 gave 8.84 per cent. ether extract. Further extraction for 3 hours gave .24 per cent. The residue yielded to boiling chloroform in 4 hours 3.35 per cent. and nothing on further extraction with carbon bisulphide.

Seven grams of fish No. 1451 treated as above yielded 8.19 per cent. of ether extract, 1.39 per cent. chloroform extract.

The seven grams of Fish No. 1479 contained..........	.5677	grams of nitrogen.
The total residue after extraction "	.5399	
Extracted by ether and chloroform	.0278	

or 0.39 per cent. of nitrogen.

The seven grams of Fish No. 1451 contained..........	.2807	grams of nitrogen.
The total residue after extraction "	.2517	
Extracted by ether and chloroform	.0290	

or 0.41 per cent. of nitrogen.

No attempt was made to ascertain the nature of the nitrogenous matter which was soluble in ether and chloroform. It may possibly have been lecithin which is found in fish eggs.

Portions of 2 grams of these extracted samples were digested in the usual way for 12 hours. The calculated results are as follows :

No. 1479 before extraction had .5677 grams nitrogen × 54.3 per cent. soluble............... =.3082 grams soluble nitrogen.
After extraction had .5399 grams nitrogen × 53.3 per cent. soluble............... =.2878 grams soluble nitrogen.

If the nitrogen removed by ether and chloroform would have been soluble in pepsin solution, then the total soluble nitrogen after extraction with ether would be .3156, and the percentage solubility of nitrogen in the extracted sample, 55.6, a gain of only 1.3 per cent. in solubility over the sample which contained oil.

A similar experiment with No. 1451 gave practically the same result.

As a further test, samples of 2 grams each of blood No. 1, and of bone No. 1197, were weighed into beakers, and to each was added about .20 grams (10 per cent.) of fish oil. The beakers stood in a room where the temperature was little below 70° Fahr. by day and 10–20 degrees lower at night.

After a month the solubility of nitrogen in the blood was 97.9 per cent., in the bone 95.6 per cent. as against 96.8 and 98.8 respectively, in the trials previously made without any addition of oil. After nearly two months the solubility of nitrogen in fish was 98.0 per cent., in bone 96.1 per cent.

That the comparatively low solubility of nitrogen in fish is due to some change in it during the drying and storing is indicated by the fact that the nitrogen of fresh cooked menhaden is much more freely soluble in acid pepsin solution (see fish No. 1598) than that of the fish dried and cured in the usual way.

Effect of Salt.

A certain quantity of salt in solution will depress the solvent action of acid pepsin. To learn how far this fact might go towards explaining the behavior of fish scrap with pepsin solution, certain samples were washed with water previous to extraction till the washings were free from chlorine. The results of digestion were as follows:

		Of the total nitrogen, there were dissolved per cent.	
No.	Time of digestion. hours.	In the washed sample.*	In the unwashed sample.
1479	24	57	61
1451	24	71	69
1425	36	71	73
1587	36	56	60
1501	24	64	64

These trials indicate that the amount of salt present in these samples has no marked effect on the solubility of nitrogen.

Presence of gelatin or glue.

In the process of extracting fish oil, the fresh fish are cooked for 20 minutes or half an hour in open tanks, in water which is heated by steam, led into it under more or less pressure. It is possible that by this means more or less glue is produced which is known to be very slowly soluble in pepsin solution. To remove any glue, two grams of fish No. 1587 were heated with water to boiling, the solution was filtered, the boiling was repeated and finally the residue was brought on to the filter and washed with hot water. A sample of bone, 1363 was treated in the same way. These residues were then digested with pepsin solution for 12 hours. The results were:

---

* Including what nitrogen was removed by the preliminary washing.

	Of the total nitrogen were dissolved per cent. In original sample.	In the treated sample.*
Fish No. 1587	50	56
Bone No. 1363	67	69

Effect of a long continued digestion without additional acid.

Different portions of fish 1501, were digested for 12, 24, 48 and 60 hours in the usual way, except that no acid was added during digestion to that already in the pepsin solution. Samples of leather were treated in the same way as a control on the experiment described on page 122.

The results were as follows:

Time of digestion. Hours.	Of the total Nitrogen were dissolved, per cent. Fish No. 1501.	Leather No. 8.
12	53	41
24	57	47
48	65	52
60	69	49
60	76†	54†

But nothing so far discovered fully explains the rather low solubility of dry ground fish in pepsin solution.

The solubility of nitrogen in various grades of bone was next determined as follows:

The first three samples in the table which have the highest solubility are known to be raw, hard, selected bone, free from adhering flesh and from any large amount of grease. No. 1354 is a residue from glue works. It has been steamed and all glue removed. Nos. 1363, 1525, and 1433 at the bottom of the list, are residues containing little hard bone but mixed with salt and salt-cake. A sample of No. 1363 was washed with water to remove the salt cake, before digestion, but the solubility of its nitrogen was not affected by the treatment.

The nitrogen of hard raw bone is considerably more soluble than that of the mixture of soft bone with cartilage muscular

---

* Including nitrogen removed by boiling water.

† In these two cases at the end of thirty-six hours the solution was removed by filtration, fresh pepsin solution was added, and the digestion continued for twenty-four hours. The slow continued solution of leather by pepsin solution when the amount of free acid is not over 0.2 per cent. is here apparent as in the other experiment.

Station No.	Per cent. of Nitrogen.				Of the total Nitrogen were dissolved per cent.
	Total.	Insoluble in pepsin solution. (Duplicate trials.)		Insoluble average.	
1197	4.11	.40	.60	.05	98.8
1405	5.40	.20	.22	.21	96.1
1561	4.14	.27	.25	.26	93.7
1354	1.62	.15	.18	.16	89.0
1436	4.38	.50	.61	.55	87.2
1375	3.53	.45	.47	.46	87.0
1371	3.90	.63	--	.63	84.0
1353	4.10	.61	.68	.64	84.4
1565	3.69	.79	.52	.65	82.4
1402	3.16	.68	--	.68	78.5
1564	4.48	1.13	--	1.13	74.8
1431	2.93	.79	.78	.79	73.0
1361	6.04	1.68	1.59	1.64	72.8
1394	3.40	.91	.91	.91	73.2
1398	4.14	1.29	1.36	1.32	68.1
1368	3.84	1.20	1.29	1.24	67.7
1363	3.70	1.13	1.18	1.15	68.9
1525	3.55	1.25	1.29	1.27	64.2
1399	4.43	1.63	---	1.63	63.2
1433	2.63	1.29	1.20	1.25	52.5

tissue and grease, which makes up "kitchen bone." It may be too that the process of boiling or steaming as usually conducted partly converts cartilage into glue, which is less soluble in pepsin solution, although it decays more readily than other forms of albuminoid matter.

The nitrogen of Peruvian guano directly treated with pepsin solution does not readily go into solution. From a sample containing 16.01 per cent. of nitrogen, pepsin solution dissolved only 11.14 per cent., or 69 per cent. of the total nitrogen present. The reason is that guano contains a considerable proportion of nitrogen in the form of uric acid, which is insoluble in water and dilute acid, although it is easily resolved into ammonium carbonate by fermentation, and so becomes available. Stutzer & Kleinkenberg propose to remove uric acid by digesting two grams of guano with 250 c. c. of a 1 per cent. borax solution for two hours on a water bath, and afterwards digesting the residue with pepsin solution. The guano above referred to, treated in this way, had its nitrogen dissolved to the extent of 98.3 per cent.

In the case of mixed fertilizers, however, such treatment is inadmissible, because leather itself gives up its nitrogen after treatment with borax. Thus, a sample of leather, reduced by superheated steam, after treatment with borax, gave up 83.8 per cent. of nitrogen to pepsin solution, while only 33.3 per cent. of it was soluble in pepsin solution without the treatment with borax. It is easy, however, to detect uric acid in any mixture, so that in any case due account may be given to it.

To illustrate the practical application of the method, four samples of superphosphates were prepared as follows:

A		
24	grams	leather,
7	"	sulphate of ammonia,
8	"	muriate of potash,
61	"	S. C. acid phosphate.
100		

B		
13	grams	black blood,
29.3	"	steamed leather,
8.5	"	muriate of potash,
49.2	"	S. C. acid phosphate.
100		

C		
39	grams	cave guano,
7	"	sulphate of ammonia,
6	"	muriate of potash,
48	"	S. C. acid phosphate.
100		

D		
13	grams	black blood,
5	"	horn and hoof,
8	"	muriate of potash,
74	"	S. C. acid phosphate.
100		

The analyses of the mixtures are:

	A	B	C	D
Nitrogen	3.47	3.75	3.56	2.44
Phosphoric acid	9.1	7.4	7.2	11.1
Potash	4.3	4.5	3.2	4.3

A contained 2.02 per cent. of nitrogen from leather, and 1.45 per cent. from sulphate of ammonia. **B** contained 1.75 per cent. from blood, and 2.00 from leather. **C** contained 2.11 from cave guano and 1.45 from ammonia, and **D** 1.75 from blood and .69 from horn and hoof.

Four portions, of 5 grams of each sample, were washed on a filter with about 400–500 c. c. of cold water. In two of these portions the *nitrogen insoluble in water* was determined, in the other two samples was determined the *nitrogen insoluble in water and in pepsin solution.*

The results were as follows:

	A	B	C	D
Nitrogen insoluble in water	2.05	3.74	1.66	2.44
Nitrogen insoluble in water and in pepsin solution	1.57	1.66	1.43	.62

From this is calculated that of 100 parts of nitrogen insoluble in water (organic) are dissolved by pepsin solution:

	A	B	C	D
Nitrogen dissolved	23.4	55.6	13.8	74.6

Samples **A** and **C** are clearly condemned by their low solubility. The chemist who made the determinations, being ignorant of the composition of the samples, also reported that tannic acid was present in both **A** and **B**. This fact, taken with the low solubility of **B** would condemn that also. Sample **D**, which contains between one-third and one-fourth of its nitrogen in form of horn and hoof, would not be suspected of containing an inferior ammoniate.

REVIEW OF THE RESULTS OBTAINED BY DRS. SHEPARD AND CHAZAL AND THIS STATION.*

1. The nitrogen of dried blood red and black (4 samples), cotton seed (4 samples), castor pomace and maize refuse (each one sample) was in every case soluble in pepsin solution, by 24 hours digestion, to the extent of 75 per cent. or more.
2. The nitrogen of fish (10 samples), dried animal matter (tankage, horse-meat, etc., 3 samples) and of bone (20 samples), was in every case soluble to the extent of over 52 per cent.
3. The nitrogen of leather steamed or extracted by benzine was in no case soluble to the extent of over 36 per cent. That of horn shavings, horn dust, ground horn and hoof, cave guano, felt waste and wool waste was considerably less soluble than the nitrogen of leather.
4. This method divides all ammoniates into two classes according to the solubility of their nitrogen. In one class more than half of the nitrogen is soluble, in the other scarcely more than one-third is soluble. In the first class belong *all* the ammoniates whose nitrogen is known to be "available" in the sense referred to in the beginning of this paper, in the second class the most soluble are leathers variously manipulated which are known to be almost valueless as fertilizers. To some extent this method is therefore a measure of the agricultural value of nitrogen. How far it is a measure must be determined by vegetation experiments under accurately controlled conditions in which nitrogen is supplied in the same ammoniates which have been tested by digestion experiments.

In the mean time the method has decided value because in many cases it will distinguish in mixed fertilizers between such ammoniates as the general sense of practical farmers accepts as available and such as the same general sense condemns as inert.

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*Stutzer and Klinkenberg's results are not here repeated because they apply to ammoniates which probably differ from ours somewhat in method of preparation, etc.

Experiments on the Putrefaction of Ammoniates.

Some experiments have also been made on the relative rapidity of the solution of nitrogen in various ammoniates when exposed to putrefactive fermentation, a method proposed by Morgen.*

The materials above described were used for this study. The method employed was to bring one gram of the substance into a precipitating flask with 350 c. c. of water and 5 c. c. of an aqueous extract of rotting stable manure. The flasks were kept in a water bath at 30° C. (28°-35°), shaken once daily, and fresh water was added when necessary to replace what evaporated. After two weeks digestion the solutions were filtered and nitrogen was determined in the washed residue.

The results are here presented in tabular form:—

MATERIAL.	PER CENT. OF NITROGEN.			Of the total Nitrogen, were dissolved, per cent.
	Total.	Undissolved.	Average.	
Blood. No. 1,	13.44	3.12	3.12	76.8
Blood, No. 2,	13.47	4.64	4.64	65.6
Ammonite, No. 1536,	12.85	3.00—3.32	3.16	75.4
Fish, No. 1598,	10.68	2.63—2.03	2.33	78.1
Fish, No. 1479,		3.45—3.86	3.65	54.6
Fish, No. 1501,		3.50	3.50	59.8
Dry Horse Meat,	8.12	2.77—3.40	3.08	62.0
Bone, No. 1525,		1.36	1.36	61.7
Bone, No. 1561,		.91—.82	.86	79.0
Cotton Seed,	6.68	1.45—1.36	1.40	78.9
Castor Pomace,	6.88	1.87	1.87	72.8
Maize Refuse,	5.55	.77	.77	86.1
Cave Guano,	5.41	4.45—4.40	4.42	18.3
Buffalo Horn Saw Dust,	14.85	12.10—14.87	12.10	18.5
Horn Shavings,	15.37	12.33	12.33	19.8
Ground Horn and Hoof,	13.69	9.94—9·46	9.70	29.1
Leather, No. 3,	8.13	7.14	7.14	12.2
Steamed Leather,	6.85	4.14—3.77	3.95	42.3
"Prepared Ammonite,"	8.06	5.18	5.18	35.7

In some cases the duplicate nitrogen determinations do not agree closely which indicates that putrefaction did not go on as rapidly in one case as in the other. There is much less variation in the solubility of the nitrogen of the different ammoniates whose nitrogen is available than was noticed in case of digestion with pepsin solution.

---

* Landwirthsch. Versuchs-Stationen, 1880, 50.

In the latter case from 52 to 98 per cent. of nitrogen was dissolved, but by this putrefaction test from 54 to 86.

This test of putrefaction draws the same line between the two classes of ammoniates that was drawn by the pepsin digestion.

Steamed leather, "Prepared Ammonite" and horn and hoof which were the most soluble of their class in pepsin solution are also the most soluble after putrefaction.

This method is deserving of further examination.

The experiments described in this paper have been almost wholly carried out by Mr. E. H. Farrington and Mr. A. L. Winton, Jr., chemists in this station.

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HON. E. H. HYDE, Stafford, *Vice-President.* July

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PROF. W. O. ATWATER, Middletown.

Appointed by Governor and Senate:
EDWIN HOYT, New Canaan.
H. L. DUDLEY, New London.

Appointed by Board of Agriculture:
T. S. GOLD, West Cornwall.

Executive Committee.

Appointed by Governing Board of Sheffield Scientific School:
W. H. BREWER, New Haven, *Secretary and Treasurer.*

Ex-officio.
S. W. JOHNSON, New Haven, *Director.*

Chemists.
E. H. JENKINS, PH.D., *Vice-Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, JR., PH B.
T. B. OSBORNE, PH.D.

In charge of Buildings and Grounds.
CHARLES J. RICE.

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, milks, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, etc., etc., for the citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 21.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in duly authenticated samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be *prepaid*, and all communications should be directed, *not to individual officers*, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban st., between Whitney avenue and Prospect st., 1⅜ miles North of City Hall. Suburban st. may be reached by Whitney Lake Horse Cars, which leave corner of Chapel and Church sts. each hour and half hour.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State st., or from Peck & Bishop's Office in Union R. R. Depot.

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REPORT OF THE BOARD OF CONTROL.

To the General Assembly:

The Board of Control of The Connecticut Agricultural Experiment Station begs leave to present herewith its Tenth Annual Report. The Experiment Station has been engaged during 1885 as in previous years, chiefly with the analysis of Commercial Fertilizers and Feeding Stuffs. The State "Law concerning Fertilizers" in its 9th Section requires the Director of the Station to make and publish annually at least one analysis of each Commercial Fertilizer sold in Connecticut. The number of brands of Commercial Fertilizers legally sold in the State during the year has been 134, and of some of these it has been necessary to make two or more analyses. This work has been on hand during the entire year and has mostly employed the time of the Station chemists from April to November.

An Act passed at the last session of the General Assembly entitled "An Act to Prevent and Punish Fraud," in its fifth section provides that "The Dairy Commissioner may have samples, suspected to be imitation butter, analyzed at the Connecticut Experiment Station, or by any State Chemist, and a sworn or affirmed certificate of the analyst shall be *prima facie* evidence of the ingredients and constituents of the sample analyzed." Since this law went into effect the Station, at the request of the Dairy Commissioner, has examined fifty suspected samples, thirty-five of which proved to be imitation butter. In nearly all the prosecutions brought by the Commissioner for violation of the law it was deemed needful that either the Director or Vice-Director of the Station should attend court to give evidence. In connection with this work necessarily a good deal has been done in testing

methods of butter analysis and in gathering statistics o
composition of genuine butter.

During the last winter a feeding experiment was carri
with sheep on the digestibility of gluten meal. Consid
labor has also been bestowed on methods of soil-analysis a
vegetation experiments with reference to the relative ferti
value of horn shavings and ground horn and hoof. The S
records show that the Station has analyzed 263 fertilize
feeding stuffs and 73 samples of milk. It has published ar
tributed four printed Bulletins, each averaging ten pages, i
tions of 5,000 copies, and has issued eight "weekly statem
printed by the hektograph process and supplied to the Ag
tural Press and to the Secretaries of Farmers' Clubs and
cultural Societies. The requirement that Reports to the G
Assembly are to be prepared and printed on or before Nov
1st, cannot well be carried out in respect to the details c
work, which properly constitute the Report of the Direc
this Station. That Report is valuable to farmers and gar
especially, because it puts into their possession an accura
complete account of the composition and relative values of
commercial fertilizers and of most of the concentrated
foods found in our markets. These analyses furnish indis
ble data to practical farmers in arranging their operations f
coming agricultural year which begins in the early spring
is of the highest importance to them that the information
complete as possible and be brought down to the latest
The Director cannot finish his Annual Report in a manner
factory to the agriculturists of the State until the work of
the entire calender year is completed. To close the Station
in September as would be necessary in order to make and p
Report before November 1st, would in our opinion serious
pair the practical usefulness of the Station. Furthermor
printing of the Director's Report is necessarily slow, grea
and repeated proof-reading being required to insure corre
of the numerous tables of analyses which it contains.

The Director's Report for 1886 is in preparation, but it cannot be ready for the printer until well into December and the printing and proof-reading will require a month or more for their completion. It is expected to be mostly or entirely in type at the time designated in the Act establishing the Station for the regular annual meeting of this Board, viz: "on the third Tuesday in January." To that Report we beg leave to refer for full details of the doings of the Station.

In order to be able to respond with promptitude to the requisitions of the Dairy Commissioner it was needful to increase the working staff of the Station, and since May, Dr. T. B. Osborne has been engaged. The Station has enjoyed during July and August the valuable volunteer assistance of Professor J. H. Washburn of the Storrs Agricultural School, and of Dr. E. A. Schneider, late of Johns Hopkins University.

The Director finds that the Station laboratory is already insufficient for the increasing amount of work that is required to be done. The laboratory was conformed as respects its space and outfit to the appropriation made by the General Assembly in 1882, "for the purpose of buying a suitable lot and erecting thereon buildings and equipping the same for the permanent use of the Station." It was then foreseen that the Station would soon outgrow the laboratory thus built and furnished at a cost of about $8,000, and the building was accordingly so planned as to admit of extension without disturbing its arrangements. An addition to the laboratory building, and to the apparatus and appliances for its work and an increased annual appropriation must shortly be provided if the Station is to meet the growing demands made upon it in a satisfactory manner.

HENRY B. HARRISON,
President.

WILLIAM H. BREWER,
Secretary.

November 1st, 1886.

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with the Connecticut Agricul*
Experiment Station.

July 1st, 1885 to June 30th, 1886.

Receipts.

Balance from old account	$13.33	
Annual Appropriation	8,000.00	
Analysis Fees	3,781.19	
Sale of Bulletins and Reports	38.75	
Repayment of Customs Duties	28.00	
		$11,86

Expenses.

Salaries	$7,231.00	
Laboratory expenses	1,290.03	
Grounds and Establishment, repairs and improvements	966.91	
Printing	249.67	
Stationery	182.55	
Postage	201.01	
Library	97.75	
Collecting Fertilizers	126.80	
Traveling expenses of Board of Control	35.05	
Telephone	100.00	
Water	154.00	
Gas	250.99	
Fuel	524.25	
Insurance	203.25	
Miscellaneous sundries	55.13	
Balance on hand	192.88	
		$11,86

WM. H. BREWER, *Treasur*

Memorandum.

There is due the Station three hundred and thirty-one ($ dollars, unpaid Analysis Fees.

WM. H. BREWER, *Treasur*

REPORT OF THE DIRECTOR.

During the year 1885 the work of the Station has gone on without interruption. The analysis of commercial fertilizers as in past years has occupied the larger part of the time and attention of the Station's working force.

The number of brands of fertilizers legally sold in the State the past season was 135. The Station is required by law to make and publish at least one analysis of each of these, and other analyses made of commercial and home-mixed fertilizers, manures and waste products used for composts has brought the total number of analyses up to 280. Since in all cases the Station makes at least two analyses on each sample and sometimes more to insure accuracy, the actual number of analyses of fertilizers is about 560.

Twenty-four proximate analyses, mostly of feeding stuffs, have been made and the results of all accessible American analyses of this kind which have been published during the year have been incorporated in tables to be found in this report. About eighty milk analyses have been made and some work has been done in testing methods of analysis, etc., part of which is not yet ready for publication.

At the request of Hon. J. B. Tatem, the Dairy Commissioner, the Station has examined 61 samples of suspected butter obtained by the Commissioner in different parts of the State. Forty-seven of these were proved to be imitation butter. In thirty-nine cases suit was brought by the Commissioner against dealers in this article and in every case conviction was secured.

In connection with this work methods of butter analysis have been tested and statistics gathered in regard to the composition of pure butter made in the State. In the latter work valuable and gratuitous assistance has been rendered by Prof. J. H. Washburn of the Storrs Agricultural School.

A series of vegetation experiments has been carried out on the relative fertilizing value of horn and hoof, horn shavings and dried blood, the results of which are to be found in this R During last winter a feeding experiment was carried on sheep, on the digestibility of gluten meal from which val results were anticipated, but the trial was a failure as regar main question to be investigated because of the extremely quality of the hay purchased for use as a maintenance r Two samples of milk suspected of being poisoned were exa with negative results.

The Station has published and distributed in editions of copies, four printed bulletins, each averaging ten pages. T ject of these Bulletins is to place in the hands of those conc the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mai every post-office in the State. The package is directed postmaster, with a request to distribute to farmers. The nu sent will be increased in any case on application. The dis tion of these Bulletins is of course optional with the postm

The Bulletins are also regularly sent to every newspaper State, and to the Secretary of each agricultural society, fa club and grange whose address is known to the Station.

The Bulletins are regularly sent, also, on application, private address in Connecticut. Such application, as a rule be renewed annually.

To citizens of other States remitting fifty cents, the pu tions of the current year, including Bulletins and Annual R are mailed as they appear. Applications should be made ea the year.

The Station has also issued eight Weekly Statements p by the hektograph process and supplied as far as possible agricultural press, and to Secretaries of farmers' clubs an cultural societies.

The necessary Station correspondence increases from y year. During the last twelve months, this has involved the ing of something over 1300 manuscript letters and repo analyses.

THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a Fertilizer Law which went into effect September 1, 1882, and which repealed and took the place of all previous legislation on this subject. The law is still in force without any amendment. Since a full understanding of the provisions and penalties of this law is important to all who buy or sell commercial fertilizers the law is here reprinted and attention is specially directed to the following points :

1. In case of fertilizers that retail at ten dollars or more per ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a *certified statement* of composition. net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a *sealed sample* shall be deposited with him by the MANUFACTURER OR IMPORTER. Section 2.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

4. All "CHEMICALS" that are applied to land, such as : Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Lime (Gypsum or Land Plaster), Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 9 of the Act.

Here follows the full text of the law, with explanatory footnotes.

AN ACT CONCERNING COMMERCIAL FERTILI

GENERAL ASSEMBLY,
January Session, A. D. 1

***Be** it enacted by the Senate and House of Representati*
General Assembly convened:

Printed statement to be affixed to all packages and to go with all lots.

SECTION 1. Every person or company who shall sell, of
expose for sale, in this State, any commercial fertilizer or m
the retail price of which is ten dollars, or more than ten
per ton, shall affix conspicuously to every package ther
plainly printed statement, clearly and truly certifying the n
of net pounds of fertilizer in the package, the name, bra
trade-mark under which the fertilizer is sold, the nam
address of the manufacturer, the place of manufacture a
chemical composition of the fertilizer, expressed in the ter
manner approved and currently employed by the Conn
Agricultural Experiment Station.*

If any such fertilizer be sold in bulk, such printed stat
shall accompany and go with every lot and parcel sold, o
or exposed for sale.

Before sale *certified copies* of statement, and *Sealed Sample* to be deposited with Director.

SEC. 2. Before any commercial fertilizer, the retail p
which is ten dollars, or more than ten dollars per ton, i
offered, or exposed for sale, the manufacturer, importer, or
who causes it to be sold, or offered for sale, within the S
Connecticut, shall file with the Director of the Connecticut
cultural Experiment Station two certified copies of the stat
named in section one of this act, and shall deposit wit

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* A statement of the per cents. of Nitrogen, Phosphoric Acid (P_2
Potash (K_2O), and of their several states or forms, will suffice in mos
Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may
given when actually present in ammonia salts, and "ammonia equiva
nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given se
or together, and the term "available" may be used in addition to,
instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the
composition may take account of the two ingredients: Nitrogen, Phosphor

For Potash Salts give always the per cent. of Potash (potassium oxid
of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as foun
Station Reports.

Director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

Analysis Fee to be paid annually on or before May 1st.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

Yearly Report to Station of Dealers or Agents.

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

Leather.

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* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

On receipt of statements, samples and analysis-fees, the Station will issue Certificates of Compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

Fish-guano, &c.

SEC. 6. Every manufacturer of fish guano, or fertiliz which the principal ingredient is fish or fish-mass from whi oil has been extracted, shall, before manufacturing or heati same, and within thirty-six hours from the time such fish o has been delivered to him, treat the same with sulphuric other chemical, approved by the director of said expe station, in such quantity as to arrest decomposition: *pr however*, that in lieu of such treatment such manufacture provide a means for consuming all smoke and vapors arisin such fertilizers during the process of manufacture.

Fines.

SEC. 7. Any person violating any provision of the for sections of this act shall be fined one hundred dollars for t offense, and two hundred dollars for each subsequent violat

Fertilizers for private use.

SEC. 8. This act shall not affect parties manufacturing, i ing, or purchasing fertilizers for their own private use, and sell in this State.

Director's duties and authority.

SEC. 9. The director of the Connecticut Agricultural ment Station shall pay the analysis-fees received by him i treasury of the station, and shall cause one or more ana each fertilizer to be made and published annually. Said d is hereby authorized, in person or by deputy, to take sam analysis from any lot or package of manure or fertilizer may be in the possession of any dealer.

Bulletins.

SEC. 10. The director of the Connecticut Agricultural shall, from time to time, as bulletins of said station n issued, mail or cause to be mailed two copies, at least, bulletins to each post-office in the State.

Repeal of former acts.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen a teen, and title twenty, chapter twelve, section five of the statutes, and chapter one hundred and twenty of the pub of 1881, being an act concerning commercial fertilizers, are repealed.

SEC. 12. This act shall take effect on the first day of Sept 1882.

It will be noticed that the State exacts no license tax either for m dealing in fertilizers. For the safety of consumers and the benefit o manufacturers and dealers, the State requires that it be known what is o sale, and whether fertilizers are what they purport to be. With this view the law provides, in section 9, that all fertilizers be analyzed and it the parties making or selling them to pay for these analyses in part; itself paying in part by maintaining the Experiment Station.

OBSERVANCE OF THE FERTILIZER LAW.

1. **MANUFACTURERS who have paid Analysis Fees as required by the Fertilizer Law, and Fertilizers for which the Fees have been thus paid for the year ending May, 1887.**

Firm.	*Brand of Fertilizer.*
Adams & Thomas, Springfield, Mass.	Adams' Market Bone Fertilizer.
Apothecaries Hall Co., Waterbury, Conn.	Victor Phosphate.
Baker, H. J. & Co., 215 Pearl St., New York.	A. A. Ammoniated Superphosphate.
	Pelican Bone Fertilizer.
	Potato Fertilizer.
	Corn Fertilizer.
	Tobacco Fertilizer.
	Castor Pomace.
Bennett, P. W., Middlefield, Conn.	Ground Bone.
Bosworth Bros., Putnam, Conn.	Superphosphate of Lime.
	Ground Bone.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Grain Manure.
	" Forage Crop Manure.
	" Vegetable Manure.
	Bowker's Hill and Drill Phosphate.
	" Dissolved Bone.
	" Fish and Potash.
	" Dry Fish.
Bradley Fertilizer Co., 27 Kilby Street, Boston, Mass.	Bradley's Superphosphate.
	B. D. Sea Fowl Guano.
	Original Coe's Superphosphate.
	Complete Manure for Corn and Grain.
	" " Potatoes and Root Crops.
	Complete Manure for Top Dressing Grass and Grain.
	Circle Brand Bone and Potash.
	Fish and Potash, Anchor Brand.
	" " Triangle A Brand.
Buffalo Fertilizer and Chemical Works, Buffalo, N. Y.	Crocker's Buffalo Ammoniated Superphosphate.
	Crocker's Buffalo Potato, Hop and Tobacco Phosphate.
	Crocker's Pure Fine Ground Bone.
Clark's Cove Guano Co., New Bedford, Mass.	Great Planet A Brand.
	" B Brand.
	Bay State Fertilizer.
	Unicorn Ammoniated Superphosphate.
Coe, E. Frank, 16 Burling Slip, New York City.	Excelsior Guano.
	High Grade Ammoniated Bone Superphosphate.
	Alkaline Bone.
	Ground Bone.
Coe, Russell, Tremley, N. J.	Ammoniated Superphosphate.
Collier White Lead & Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford, Conn.	Collier Castor Pomace.
Common Sense Fertilizer Co., Boston, Mass.	Common Sense Fertilizer No. 2.
	" " No. 3.
Cooper's, Peter, Glue Factory, 17 Burling Slip, N. Y.	Peter Cooper's Bone Dust.

Firm.	*Brand of Fertilizer.*
Curtis, J. G., Elliot, Conn.	Ground Bone.
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Darling's Fine Bone. " Animal Fertilizer. Eagle Brand Bone.
Dickenson, D. B., Middle Haddam, Conn.	Ammoniated Bone Superphosph
Harris & Son, Eagleville, Conn.	Bone. Superphosphate.
Hurtado & Co., 16 & 18 Exchange Place, New York.	Peruvian Guano, Standard.
Kelsey, E. R., Branford, Conn.	Fish and Potash.
Lamb, J. A., 238 State Street, Hartford, Conn.	Church's Fish and Potash, Bran
Lister Agricultural Chemical Works, Newark, N. J.	Ground Bone. Standard Phosphate. Ammoniated Dissolved Bone. Potato Manure. U. S. Superphosphate.
Mapes' Formula and Peruvian Guano Co, 158 Front St., New York.	Mapes' Potato Manure. " Corn Manure. " Complete Manure [Light " " " [Gener " Tobacco " [Conn. " " " [for u stems.] Mapes' Complete Manure [A Br " Nitrogenized Superphos " High Grade Superphosp " Fine Dissolved Bone. " Muriate of Potash. " Nitrate of Soda. " Sulphate of Ammonia. " Ground Bone. " Grass and Grain Spri Dressing.
Meyer, C., Jr., Maspeth, L. I.	Acme Fertilizer No. 1. " No. 2.
Miles, G. W., Agent, Milford, Conn.	I. X. L. Ammoniated Superphos Fish and Potash, "Fish Brand."
Miller, G. W. Middlefield, Conn.	Flour of Bone Phosphate. Pure Ground Bone.
Mitchell, A., Linden, N. J.	Mitchell's Phosphate.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Fish and Potash. " Ammoniated Bone phosphate. " Complete Fertilizer " Fine Animal Bone.
New Haven Fertilizer Co., New Haven, Conn.	Standard Superphosphate.
Newton & Ludlam, 182 Front St., New York.	Cereal Fertilizer. Cecrops or Dragon's Tooth Fert Animal Bone.
Olds and Whipple, Hartford.	Cotton Hull Ashes.
Peck Brothers, Northfield, Conn.	Pure Ground Bone.
Plumb & Winton, Bridgeport, Conn.	Bone Fertilizer. Ground Bone.
Preston Fertilizer Co., Green Point, L. I.	Preston's Ammoniated Bone Sup phate. " Ground Bone.

Firm.	*Brand of Fertilizer.*
Quinnipiac Fertilizer Co., New London, Conn.	Quinnipiac Phosphate. " Extra Superphosphate. Quinnipiac Potato Manure. " Bone Meal. " Fish and Potash Crossed Fishes Brand. Quinnipiac Fish and Potash Plain Brand. Dry Ground Fish. Muriate of Potash. Nitrate of Soda.
Read & Co., 88 Wall St., New York.	Cook's Blood Guano. " Dissolved Ground Bone.
Rogers & Hubbard Co., Middletown, Conn.	Ground Bone—Meal. " Bone, Grade A. " Bone, Grade AX. Muriate of Potash. Nitrate of Soda.
M. L. Shoemaker & Co., Philadelphia, by F. Ellsworth, Hartford, Conn.	Swift-Sure Bone Meal. " Superphosphate.
Smith, Edmund, South Canterbury, Conn.	Ground Bone.
Soluble Pacific Guano Co., Glidden & Curtis, Agents, Boston, Mass.	Soluble Pacific Guano. Golden Leaf Fertilizer. Fish and Potash.
I. L. Spencer, Suffield, Conn.	Cotton Hull Ashes.
Stearns & Co., 181 Front St. New York.	Ammoniated Bone Superphosphate. Eagle Brand Fish and Potash. Ground Fish Guano.
Thompson, Gilbert, 249 Front St., N. Y.	Bone Fertilizer.
Thomson, Paul, Hartford, Conn.	Charter Oak Fertilizer.
Wilkinson & Co., 239 Center St., N. Y.	Wilkinson's Ammoniated Superphosphate.
Williams, Clark & Co., Hanover Square, New York.	Americus Superphosphate. Bone Meal. Dissolved Bone Black. Dry Ground Fish. Dried Blood. Fish and Potash. Kainite. Muriate of Potash. Potato Phosphate. Tobacco Phosphate. Royal Bone Phosphate.

2. **Dealers** who have complied with the law by furnishing the Director of the Station with the information required in the 4th section :

Alford, G. H., Winsted.
Anderson, W. H., Putnam.
Blakeslee, Jacob, Watertown.
Barstow, J. P. & Co., Norwich.
Benton, C. E., Sharon.
Brownell, E. C., Moodus.
Boswell, J. W., Sterling.
Case, S. E., New Hartford.
Ellsworth, F., Hartford.
Griffiths, S., Sterling.
Gifford, H. M.. East Woodstock
Hopson, Geo., Kent.
Kingsley, Andrew, Coventry.
Kingsley, J. P. & Son, Plainfield.
Lord, C. C., Cheshire.
Munson, S. A., Riverton.
Pratt, Chas. M., Westbrook.
Smith, J. E., East Granby.
Tayler & Hubbell, Newtown.
Tucker. R. H., Saybrook.
Wilson & Burr, Middletown.
Warner, D. B., East Haddam.

Section 7 of the law imposes on those who violate the pr provisions a penalty of one hundred dollars for the first and two hundred for each subsequent offence.

The failures of most of the dealers to comply with secti the law has made it difficult for the Station to find and pr collect all the brands of fertilizers which are in our mark will be necessary the coming season to secure general com with the law on the part of dealers.

ANALYSES OF FERTILIZERS.*

In respect to its terms, the Station makes *two classes* o ses of fertilizers and fertilizing materials: the first for the of farmers, gardeners, and the public generally; the sec the private use of manufacturers and dealers. Analyses *first class* are made gratuitously, and the results are publis speedily and widely as possible for the guidance of pur and consumers. Those of the *second class* are charged moderate rates, and their results are not published in a interfere with their legitimate private use. The Statio ever, distinctly reserves the liberty to use at discretion, public benefit, all results obtained in this laboratory, an case will enter into any privacy that will work against th good.

During 1886, two hundred and eighty (280) samples o zers have been analyzed. Of these, 30 were examined for parties, and the remainder for the general use of the cit the State.

Sixty-eight samples of commercial fertilizers analyzed public benefit have been sent in by purchasers and co The rest have been supplied by agents of the Station who the spring and early summer endeavored to visit all sec the State, to take samples from every brand of fertilize for sale in the State, and to take them from the stock of in remote places as well as from centers of trade.

The Station agents are instructed when drawing sa open at least three packages of each brand of goods i case, and if the number of packages is large, to take a from every tenth one, by means of a sampling tube, which withdraws a section or core through the entire length of the package.

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* The matter of this and several subsequent pages, explanatory of th and valuation of fertilizers, is copied, with a few appropriate alterations Report for 1885. This repetition appears to be necessary for the use who have not seem former Reports.

The greatest care is necessary in sampling fertilizers that the small sample taken shall accurately represent the whole stock from which it is drawn. Otherwise serious injustice may be done.

Ten out of sixty-eight samples of commercial fertilizers sent to the Station by private individuals were found, after the analyses were finished to be unfairly taken or wrongly labeled, and therefore the work spent on them was wasted.

The Station none the less desires the coöperation of farmers, Farmers' clubs and granges in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All such samples are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

GRATUITOUS ANALYSIS OF COMMERCIAL FERTILIZERS.

To insure justice to manufacturers, dealers and consumers alike, the Station henceforth will make gratuitous analyses of Commercial Fertilizers only on samples taken by the Agents of the Station or on such others as are properly authenticated by the certificate of the person drawing the sample *and in addition* the witness, either

1. Of a Selectman ;
2. Of an Officer of a farmer's club, grange or local agricultural society; or
3. Of the Dealer from whose stock the sample is taken.

4. In case a Dealer takes samples of his own stock, the witness of one of the Officers aforesaid will be required.

In special cases of importance the Station may send its Agent to draw samples.

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

1. Provide a teacup, some large papers and for each sample a glass fruit can or tin box holding about one quart that can be tightly closed, all to be clean and dry.

2. Open at least three full and unbroken packages, or if there are more than thirty, every tenth package, and mix well together the contents of each for a foot in depth, take out two cupfuls from different parts of the mixed portions of each package, pour them

[six in all] one over another upon a paper, intermix thoroughl quickly to avoid gain or loss of moisture, fill the can or box this mixture, close tightly, fix securely on the outside of the label with some distinguishing letter or mark (which is copied in the "Description of Sample" as *sampler's mark*) send prepaid to the Agricultural Experiment Station, New H Conn.

3. If convenient weigh separately at least three package enter these *actual weights* in the "Description of Sample."

4. When a sample has been taken it should *always* be bo labeled and the form for its description filled out complete *fore* beginning to sample another fertilizer.

FURTHER REMARKS ON SAMPLING.

In case of a fine, uniform and moist or coherent article, a ter-tryer or a tin tube, like a dipper handle, put well down the packages in several places, will give a fair sample with ease.

With dry, coarse articles, such as ground bone, there is to be a separation of coarse and fine parts on handling. articles put up in bags or common barrels may become d the outside. It is in these cases absolutely necessary to thoroughly the coarse and fine, the dry and the moist portio fore sampling.

The quantity sent should not be too small. When the ma is fine and uniform, a pint is enough, but otherwise and espe in the case of ground bone, which must be mechanically ana the sample should not be *less than one quart.*

It is important that samples for analysis should be taken time when the fertilizer is purchased, and *immediately dispa* to the Station. Moist fish, blood or cotton seed meal will decompose and lose ammonia, if bottled and kept in a warm Superphosphates containing much organic nitrogen will suff version of their soluble phosphoric acid under similar circum ces. Most of the moist fertilizers will lose water unless ti bottled, but some of the grades of potash salts will gather ture from the air and become a slumpy mass if not thoro protected.

Samples as to whose authenticity or fairly representative ch ter there is any reasonable doubt, the Station will not an

The Station reserves the right to reject samples taken from less than half a ton of stock or those drawn from goods that have been wintered over from last year.

Send with each sample any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

DESCRIPTION OF SAMPLE.

Station No....... Rec'd at Station,..................., 188

Each sample of Commercial Fertilizer sent for gratuitous analysis *must* be accompanied by a Description made by filling out legibly and as fully as possible, the blanks that follow :

Sampler's Mark, ...
Brand of Fertilizer,..
Name and address of Manufacturer,..............................
....
Name and address of Dealer from whom this sample was taken,
....
Date of taking this sample,......................................
Is it stated to be fresh stock ?....................................
Dealer's cash price per ton or hundred, bag or barrel, ...
Selling weight claimed for each package weighed,..............
Actual weight of the several packages opened,.................
Number of packages from which the sample was taken,........

Here write the per cents of valuable ingredients which the fertilizer is guaranteed to contain.

Soluble Phosphoric Acid,..................Nitrogen,..........
Reverted Phosphoric Acid,...............(Ammonia,.........)
(Available Phosphoric Acid,...............) Potash, ...
Insoluble Phosphoric Acid,......................................

CERTIFICATE OF PERSON TAKING THE SAMPLE.

I, the undersigned, certify that the accompanying sample marked...... was taken by me from full packages, and in accordance with the Station's Instructions for Sampling and to the best of my knowledge and belief fairly represents the stock from which it was drawn, and that said stock when sampled was properly housed and in good condition. I also certify that the foregoing description is correct.

Signature ....
Post Office address..

WITNESS OF OFFICER OR DEALER.

The above described sample was drawn in my presence.

Signature --
Title --
Township --
Post Office Address ------------------------------------

On receipt of any sample of fertilizer from the open m the filled out "Form for Description" which accompanie filed in the Station's Record of Analyses, and remains ther voucher for the authenticity of the sample and for the fact has been taken fairly, or, at least, under suitable instructio is thus sought to insure that manufacturers and dealers sh suffer from the publication of analyses made on materia does not correctly represent what they have put upon the m

The "Form for Description," when properly filled out contains all the data of cost, weight, etc., of a fertilizer are necessary for making, with help of the analysis, a val of its fertilizing elements, and estimating the fairness selling price. Neglect to give full particulars occasio Station much trouble, and it is evident that want of accur writing up the description may work injustice to the ma turers or dealers, as well as mislead consumers. It is esp important that the *brand* of a fertilizer and its *selling* shall be correctly given. The price should be that a charged by the dealer of whom it is bought, and if the art purchased in New York or other distant market, that fact be stated, and the cost at the nearest point to the consum rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, the sale of an article is only by smaller quantities, tha should be distinctly mentioned.

Samples are analyzed as promptly as possible in the or which they are received. As soon as an analysis is compl copy of it is sent to the party who furnished the sample an to the manufacturer, in order that there may be opportun explanation or protest, if desirable, before the results ar lished in the Bulletin.

With the analysis there is sent to the party furnishing th ple a printed page of "Explanations," intended to embo principles and data upon which the valuation of fertili based.

These Explanations are essential to a correct understand the analyses that are given on subsequent pages, and are, fore, reproduced here, as follows:

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

REVISED.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

Reverted (reduced or precipitated) Phosphoric acid means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and r
phosphoric acid are on the whole about equally valua
plant-food and of nearly equal commercial value. In som
indeed, the soluble gives better results on crops, in others
verted is superior. In most instances there is probably li
choose between them.

Insoluble Phosphoric acid implies various phosphates not
in water or ammonium citrate. In some cases the phospho
is too insoluble to be readily available as plant food. This
cially true of Canada Apatite. Bone black, bone-ash, Sout
lina Rock and Navassa Phosphate when in coarse pow
commonly of little repute as fertilizers though good res
occasionally reported from their use. When *very finely pu*
("floats") they more often act well, especially in connecti
abundance of decaying vegetable matters. The phosp
raw bones is nearly insoluble, because of the animal matte
bones, which envelopes it; but when the latter decays in t
the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as po
oxide, which is the valuable fertilizing ingredient of "po
and "potash salts." It should be soluble in water and
costly in the form of sulphate, and cheapest in the sl
muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this Stati
nifies finding *the worth in money or trade-value, of its fer*
ingredients. This value, it should be remembered, is *no*
sarily proportional to its fertilizing effects in any speci

Plaster, lime, stable manure and nearly all of the less ex
fertilizers have variable prices, which bear no close rela
their chemical composition, but guanos, superphosphat
similar articles, for which $30 to $60 per ton are paid,
chiefly for their trade-value on the three substances, *n*
phosphoric acid and *potash*, which are comparatively cos
steady in price. The money-value per pound of these ingr
is reckoned from the current market prices of the st
articles which furnish them to commerce.

The consumer, in estimating the reasonable price to
high-grade fertilizers, should add to the *Trade Value of th*
named Ingredients, a suitable margin for the expenses of
facture, etc., and for the convenience or other advantage i
tal to their use.

The average Trade-values or retail cost in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the New England, New York and New Jersey markets, are as follows:—

These Trade-values were agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several States during 1886.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1886.

	Cents per lb.
Nitrogen in ammonia salts	18.5
" in nitrates	18.5
Organic nitrogen in dried and fine ground fish	17
" " in guanos, dried and fine ground blood and meat	17
" " in cotton seed, linseed meal and in castor pomace	17
" " in fine ground bone	17
" " in fine medium bone	15
" " in medium bone	13
" " in coarse medium bone	11
" " in coarse bone, horn shavings, hair and fish scrap	9
Phosphoric acid, soluble in water	8
" " soluble in ammonium citrate*	7½
" " insoluble in dry ground fish	7
" " in fine bone	7
" " in fine medium bone	6
" " in medium bone	5
" " in coarse medium bone	4
" " in coarse bone	3
" " in fine ground rock phosphate	2
Potash as high grade sulphate	5½
" kainit	4½
" muriate	4½

The above trade-values are the figures at which on March 1st, the respective ingredients could be bought at retail for cash, in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to

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* Dissolved from 2 grams of the unground phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

agree fairly with the *reasonable retail price* in case of sta
raw materials such as:—

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Plain Superphosphate.

Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bone,
Ground So. Car. Rock.

TRADE VALUES IN SUPERPHOSPHATES, SPECIAL MANURES MIXED FERTILIZERS OF HIGH GRADES.

The Organic Nitrogen in these classes of goods is reckor the highest figure laid down in the Trade-Values of Ferti Ingredients in Raw Materials, namely 17 cents per pound, ing assumed that the organic nitrogen is derived from th sources, viz: bone, blood, animal matter, Peruvian guar other equally good forms and not from leather, shoddy, h any low-priced inferior forms of vegetable matter, unless th trary is ascertained.

Insoluble Phosphoric acid is reckoned at 3 cents, it assumed that it is from bone or similar source and not from phosphate, unless found otherwise. In this latter form the uble phosphoric acid is worth commercially only 2 cent pound or but two-thirds as much as if from bone. Pota rated at 4½ cents, if sufficient chlorine is present in the fert to combine with it to make muriate. If there is more P present than will combine with the chlorine, then this exc Potash is reckoned as sulphate.

In most cases the valuation of the Ingredients in Super phates and Specials falls below the retail price of these g The difference between the two figures, represents the mar turer's charges for converting raw materials into manufac articles. These charges are for grinding and mixing, baggi barreling, storage and transportation, commission to agent dealers, long credits, interest on investment, bad debts, finally, profits.

In 1886 the average selling price of Ammoniated Super phates and Guanos was $36.58, the average valuation was $ and the difference $7.16, an advance of 24.3 per cent. on the ation and on the wholesale cost of the fertilizing elements i raw materials

In case of Specials the average cost was $42.56, the average valuation $36.70, and the difference $5.86 or about 16.0 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes trade-values are disadvantageous, because two fertilizers c be compared as to their relative money-worth, when their ations are deduced from different data.

Experience leads to the conclusion that the trade-values ad at the beginning of a year should be adhered to as nearly a sible throughout the year, notice being taken of consid changes in the market, in order that due allowance may be therefor.

The Agricultural value of a fertilizer is measured by the b received from its use, and depends upon its fertilizing effe crop-producing power. As a broad, general rule, it is tru Peruvian guano, superphosphates, fish-scraps, dried blood, p salts, plaster, etc., have a high agricultural value which is r to their trade-value, and to a degree determines the latter But the rule has many exceptions, and in particular instanc trade-value cannot always be expected to fix or even to in the agricultural value. Fertilizing effect depends largely soil, crop and weather, and as these vary from place to plac from year to year, it cannot be foretold or estimated exce the results of past experience, and then only in a genera probable manner.

CLASSIFICATION OF THE FERTILIZERS ANALYZED.

The fertilizers and manurial waste products analyzed Station laboratory from November 1st, 1885, to Novembe 1886, were as follows:

Phosphate Rock	7
Thomas Slag	1
South Carolina Floats	1
Superphosphates (plain)	12
Superphosphates (ammoniated) and Guanos	121
Home-mixed Superphosphates and other Fertilizers	4
Special Manures	32
Bone Manures	29
Bone and Potash	1
Dry Ground Fish	4
Fish-Peat	1
Dried Blood	1
Tankage	3
Cotton Seed Meal	3
Castor Pomace	5

Nitrate of Soda	5
Sulphate of Ammonia	5
Sulphate of Potash	3
Muriate of Potash	11
Kainit	1
Cotton-Hull Ashes	12
Wood Ashes	3
Canada Leached Ashes	3
Tobacco Stems	1
Star Fish	1
Hen Manure	1
Peat and Muck	3
Deposit underlying Peat	1
Salt	1
Lime	1
Salt Marsh Mud and Soil	3
	280

Thirty of these samples were analyzed for private persons and are not further noticed in the Report. The remaining analyses are given in detail so far as they have any general interest, with such discussion as may make them more serviceable.

GRAND CAYMAN'S PHOSPHATE.

1861. Sample drawn from four bags sent to the Station by N. B. Powter, agent of the Grand Cayman's Phosphate Co., 181 Pearl street, N. Y. Cost not stated.

This material is a very finely pulverized phosphatic rock, represented by the agent to contain considerable iron and alumina as well as lime, which is obtained from Grand Cayman's Island in the West Indies.

It contains by our analysis:

	1861
Phosphoric acid soluble in ammonium citrate*	1.81
" " insoluble in "	27.68
Total phosphoric acid	29.49

The following analyses show the composition of this phosphate in detail.

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* Dissolved from 2 grs. phosphate by 100 c. c. neutral ammonium citrate solution, sp. gr. 1.09, in half an hour, shaken frequently at 65° centigrade.

	Analyzed by Habirshaw. 1885.	Stillw Gladdi 188
Moisture at 212°	6.15	20.0
Sand and Silica	6.02	5.6
Alumina	11.01	6.3
Oxide of Iron	4.67	3.0
Magnesia	0.63	
Lime	31.27	31.0
Phosphoric Acid	26.73	23.9
Carbonic acid	13.52	2.6
Undetermined matter		7.2
	100.00	100.0
Equivalent of Bone Phosphate	58.35	52.3

The above analyses are taken from Mr. Powter's pan
That by Stillwell & Gladding has been altered in form son
for convenience of comparison. The last named chemists
the phosphoric acid as phosphate of lime simply. The u
mined matter (besides carbonic acid) is probably for th
part combined water. Mr. Powter, we understand from r
his letters and pamphlets, claims that on sandy or calcareou
iron and alumina phosphates are more certain in their acti
preferable to phosphates soluble in water. He furthermor
us the impression that the Grand Cayman's Phosphate a
directly to the land may be expected to yield good return
for the reason that it is largely a phosphate of iron and al

The analyses however are not conclusive as to the chemic
stitution of the Rock, and while we should recommend trial
ground material, we should hesitate to rely upon it any mor
on South Carolina rock, without the positive evidence of
rience. Iron and alumina phosphates, like the lime phos
differ greatly in their solubility in ammonium citrate and p
ably also in their availability as plant food. It may be adde
"phosphoral" (an easy soluble fertilizer made from iron and
ina phosphates by the action of sulphur and heat), and
ground and *gently ignited* iron phosphate, may be very di
in their properties from this ground phosphatic rock so tha
the agricultural effect of one, that of the other cannot prope
inferred.

THOMAS SLAG.

This is a by-product of the Thomas process for ren
phosphorus from iron preparatory to the manufacture of

The phosphorus is oxydized to phosphoric acid and run off in a slag, combined chiefly with lime and perhaps iron. This slag is not homogeneous and the quantity of phosphoric acid in it varies widely according to the amount of phosphorus in the ore and the details of its treatment. As low as 11.4 and as high as 23.0 per cent. of phosphoric acid have been found in the slag of different steel works. According to Fleischer its average composition is:

Phosphoric acid	17.25
Lime	48.29
Magnesia	4.89
Protoxide of iron	9.44
Sesquioxide of iron	3.78
Protoxide of manganese	3.91
Alumina	2.04
Sulphur	.49
Sulphuric acid	.22
Silica	7.96
Water, etc.	1.73
	100.00

It cannot profitably be converted into superphosphate, but on keeping it slacks to a coarse powder, is easily brought to a high degree of pulverization and applied in that state has given favorable results, in Germany particularly, on land rich in humus. During the last year it has been introduced into this country. The following analysis was made on a sample from one bag sent to the Station by the agent, Paul Weidinger, No. 76 Pine street, N. Y.:

	1826
Phosphoric acid soluble in ammonium citrate	19.57
Phosphoric acid insoluble " "	.30

The slag was a fine meal which passed a $\frac{1}{50}$ inch sieve. It is sold bagged in New York, for $12.50 per ton. The phosphoric acid which it contains costs therefore about 3$\frac{1}{5}$ cents per pound.

PLAIN SUPERPHOSPHATES.

1661. Dissolved Bone Black. From Williams, Clark & Co., New York. Sampled by station agent from stock of E. M. Jennings, Southport. Guaranteed 15–18 per cent. available phosphoric acid.

1641. Dissolved Bone Black. Made by C. Meyer, Jr., Maspeth, L. I. Sampled and sent by G. F. Platt, Milford. Guaranteed 17 per cent. phosphoric acid.

1684. Dissolved Bone Black. Made by C. Meyer, J
peth, L. I. Sampled and sent by M. S. Baldwin, Nau
Guaranteed 17 per cent. phosphoric acid.

	1661	1641	16
Soluble phosphoric acid	15.46	12.15	16.
Reverted phosphoric acid	2.88	4.46	
Insoluble phosphoric acid	.17	1.05	
Total phosphoric acid	18.51	17.66	17.
Cost per ton	$35.00		32.

* In Naugatuck.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Samples Drawn by Station Agents.

In the following tables will be found all the analyses o
niated superphosphates, dry ground fish and guano whic
been made at this Station during the present year on
drawn by our own agents from goods of this season's n
ture which were in dealers' hands. The Station assun
responsibility both for the accuracy of the sampling
chemical analysis only on such samples. In a large nu
cases and wherever possible, two or more samples ha
drawn of the same brand of goods. For example, three
were drawn of the sixth fertilizer given in the table, Chit
Fish and Potash; one from the stock of Mr. Eaton, of Pl
one from Mr. Fowler of Milford, and the third from W
Son of East Haddam. The analysis No. 1799 was ma
mixture of equal parts of these three samples and may be
to represent somewhat more fairly the average compositio
goods than an analysis made on a single sample.

The last column of the table of analysis is "Percentag
ence between Cost and Valuation." Its significance
method of calculating it may seen by noticing as before t
analysis in the table, No. 1799. Here the cost is $35, th
tion is $32.08 and the difference between them is $2.92.
tiplying this difference, $2.92, by 100 and dividing it by t
ation, $32.08, we get the *percentage* advance of selling pr
valuation, which advance should represent the costs and
of the manufacturer in converting the raw materials into
fertilizer, selling it and collecting on his sales.

Valuation is intended to represent the fair retail cash the valuable ingredients of the fertilizer. When the valuation is subtracted from the cost, the remainder or difference represents in any case the costs and profits of manufacturing the article while the *percentage* difference furnishes a means of comparing different fertilizers whose composition is unlike, but the quality of whose ingredients is about the same. For instance, suppose there are two fertilizers, one A, selling for $50 per ton; the other B, for $30. From the analyses the valuation of A is reckoned to be $44 and that of B to be $25. The difference between the retail price and the valuation, i. e., the cost and profit of manufacture, in the case of A is $6, in the case of B $5. This of itself does not show that B is cheaper to purchase than A. In one case the advance charged by the manufacturer on $44 worth of materials was $6. In the other case he charged $5 advance on $25 worth of materials. Here there is no direct comparison. But we can compare by calculating what advance each manufacturer would make on $100 worth of materials. In the case of A it is $\frac{6}{44} \times 100$ or $13.64. In the case of B it is $\frac{5}{25} \times 100$ or $20. This is the "Percentage Difference" of the tables referred to and gives a fair comparison of different fertilizers by their valuation.

Certain brands of superphosphates on which an analysis fee has been paid do not appear in these tables, for Station agents have not found them on sale at the places which they have visited for the purpose of collecting samples and the agents who have had them on sale have failed to notify the Station as the law requires. In such cases the samples sent by the manufacturers themselves in compliance with the law, have been analyzed and the results are given on following pages.

1. *Cost price.*—The prices quoted are in all cases those which were given by the retailers at the time the samples were drawn. They were understood to be cash ton prices. They are not in all cases in accordance with the views of the manufacturers, some of whom claim to have a uniform retail price for each brand they make, and properly complain that parties acting as their agents have so advanced prices so as to make an undue increase of difference between valuation and selling price.

The Station therefore calls the attention of purchasers to the probability that they may in some cases get better terms by learning manufacturer's prices.

2. *Comparison of Cost and Valuation.*—Excluding the last three fertilizers in the table, "Common Sense" and "Charter

Oak," the average cost of 60 superphosphates has been $36.58
the average valuation $29.42. The difference, $7.16, is 24.3
cent. of the valuation. The valuation, as has been explaine
designed to cover *only retail cost of raw materials*, and does
take account of the expense of mixing, handling and selling.
24.3 per cent. should represent the average cost of these
named items *plus* the average profit which the manufacturers
made.

In former reports attention has been called to the fact that t
fertilizers which are sold at the lowest prices are not generally
most economical to buy. The tables of analyses afford ano
proof of this: The average cost of those tabulated on
first page of the tables is $36.93, and the percentage differ
between cost and valuation is 11.2, while of those on the last
of the tables the average cost is only $32.71, but the percen
difference is 36.9. That is, while the margin for cost of mi
freighting and selling and profits was 11.2 per cent. of the co
the raw materials on goods that retailed at $36.93, the same
gin was 36.9 per cent. on goods that retailed at $32.70.

3. *Guarantees.*—Sixteen out of the 63 superphosphates,
considerably below their guaranteed composition on one in
dient. In 8 cases this deficit was on potash and came about b
inaccurate (and in this State illegal) method of stating the g
antee. The law provides that the guarantee shall be "expre
in the terms and manner approved and currently employed by
Connecticut Agricultural Experiment Station." The terms
manner of statement have been clearly set forth in the report
this Station from the time the law went into force. The am
of *actual potash* must be stated. If desired, the equivalen
sulphate of potash may also be given. The phrase "Potash
phate] 4.0 per cent." correctly understood, means 4.0 per cen
actual potash in the form of sulphate and not 4.0 per cent. of
phate of potash which contains but little more than half its we
of actual potash. Only two of the superphosphates are b
their guarantees on more than one ingredient.

"Warranted No. 1 Peruvian Guano" No. 1798 is not, as
name implies, pure Peruvian Guano but is a mixture of some
uine guano with sulphate of ammonia and possibly other m
rials.

The prices of the last three fertilizers in the table, Com
Sense Fertilizers, Nos. 2 and 3, and Charter Oak Fertilizer

nearly double their valuation and their chemical analyses do not sustain the confidence which their trade names are calculated to inspire.

Church's Fish and Potash. D.

On May 5th of this year, an agent of the Station drew a sample from bags branded "Church's Fish and Potash D," which were in the stock of J. A. Lamb, 238 State St., Hartford. Mr. Lamb was held liable for the payment of the analysis fee on this article, which, after some delay and protest he paid with this request: "Please send receipt, in which I wish you to say: Received of Joseph Church & Co., by the hand of their agent, J. A. Lamb, 238 Church St., Hartford," etc. Shortly after, the Station received a letter from Joseph Church & Co. saying that J. A. Lamb was not their agent and forbidding the Station to analyze anything on Church & Co's account by Mr. Lamb's order. Since the analysis-fee has been paid on this fertilizer the Station is obliged by law to make and publish an analysis and in fairness to the parties concerned makes the above explanation. The analysis and valuation of the article is as follows:

No.	**1771.**
Nitrogen as Ammonia	.55
Organic Nitrogen,	2.96
Soluble Phosphoric Acid,	2.70
Reverted Phosphoric Acid,	1.38
Insoluble Phosphoric Acid,	1.61
Potash,	3.41
Chlorine,	5.41
Cost per ton,	$35.00
Valuation per ton,	$22.35

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.	Sampled by
1791	Fine Dissolved Bone.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	J. P. Barstow & Co., Norwich.	$35.00	Station Agent.
1819	Quinnipiac Dry Ground Fish.	Quinnipiac Fertilizer Co., N. London.	Olds & Whipple, Hartford.	40.00	"
1763	Stearns' Pure Ground Fish Guano.	Stearns & Co., 124 Front St., New York.	J. E. Leonard, Jewett City.	40.00	"
1769	Acme Fertilizer, No. 2.	C. Meyer, Jr., Maspeth, L. I.	A. R. Russell & Co., Meriden.	40.00	"
1745	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., N. London.	A. R. Russell & Co., Meriden.	45.00	"
1799	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport.	Berry & Sherman, Bridgeport.	38.00	"
			Geo. W. Eaton, Plainville.	-------	"
			Wm. M. Fowler, Milford.	35.00	"
			D. B. Warner & Son, E. Haddam.	35.00	"
1671	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	38.00	"
			P. & G. M. Williams, New London.	38.00	"
1748	Swift Sure Superphosphate.	M. L. Shoemaker & Co., Philadelphia.	J. P. Barstow, Norwich.	40.00	"
1770	Acme Fertilizer, No. 1.	C. Meyer, Jr., Maspeth, L. I.	F. Ellsworth, Hartford.	40.00	"
1755	E. Frank Coe's Alkaline Bone.	E. Frank Coe, 16 Burling Slip, New York.	A. R. Russell & Co., Meriden.	45.00	"
			Strong & Backus, Colchester.	32.00	"
1728	Bosworth Bro's Superphosphate of Lime.	Bosworth Bros., Putnam, Ct.	Manufacturer.	36.00	"
1736	Kelsey's Fish and Potash.	E. R. Kelsey, Branford, Ct.	M. S. Baldwin, Meriden.	21.–21.50	"
1735	Mapes' Complete Manure "A" Brand.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Mapes' Branch, Hartford.	38.00	"
			Birdsey & Foster, Meriden.	39.50	"
1674	Mapes' Complete for General Use.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Dean & Horton, Stamford.	40.00	"
			Dean & Horton, Stamford.	43.00	"
			Mapes' Branch, Hartford.	41.00	"
			Strong & Backus, Colchester.	39.00	"

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.	Sampled by
1679	Americus Superphosphate.	Williams, Clark & Co., Hanover Square, New York.	J. P. Root, Tolland.	$38.00*	Station Agent.
			E. M. Jennings, Southport.	38.00*	"
			Strong & Backus, Colchester.	36.00	"
			Usher & Tinker, Plainville	38.00*	"
1797	Lister's Standard Phosphate.	Lister's Agricultural Chemical Works, Newark, N. J.	S. J. Hall, Meriden.	34.00	"
			Martin Bros., Wallingford	33.00	"
1788	Golden Leaf Fertilizer.	Soluble Pacific Guano Co., Boston, Mass.	H. A. Stillman, Hartford.	42.–44.00	"
1789	Lister's U. S. Superphosphate.	Lister's Agricultural Chemical Works, Newark, N. J.	Swan's Seed Store, Bridgeport.	26.00	"
1795	Complete Manure for Light or Sandy Soils.	Mapes' Formula and Peruvian Guano Co., New York.	Wilson & Burr, Middletown.	48.00	"
			W. W. Cooper, Suffield.	48.00	"
			Mapes' Branch, Hartford.	48.00	"
1764	Soluble Pacific Guano Co.'s Fish and Potash.	Soluble Pacific Guano Co., Boston, Mass.	H. A. Stillman, Hartford.	30.–32.00	"
			Jas. Greenfield, New London.	35.00	"
1718	Baker's A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., 215 Pearl St., New York.	W. W. Cooper, Suffield.	37.50	"
			S. J. Hall, Meriden.	37.50	"
			Smith & Sons, West Cornwall.	35.00	"
1774	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Jas. Greenfield, New London.	38.00	"
1729	Great Planet Fertilizer, B Brand.	Clark's Cove Guano Co., New Bedford, Mass.	J. H. Ives, Danbury, Ct.	48.00	"
1750	Pelican Bone Fertilizer.	H. J. Baker & Bro., 215 Pearl St., New York.	G. H. Alford, Winsted.	32.50	"
1762	Stearns' Ammoniated Bone Superphosphate.	Stearns & Co., 124 Front St., New York.	A. R. Russell & Co., Meriden.	35.00	"
			J. E. Leonard, Jewett City.	38.00	"
1732	Market Bone Fertilizer.	Adams & Thomas, Springfield, Mass.	Moran Bros., Windsor Locks.	38.00	"

* The manufacturer states that this brand should not retail above $36.00 per ton.

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.	Sampled by
1782	Darling's Animal Fertilizer.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	$40.00	Station Agent.
			W. W. Cooper, Suffield.	38.00	“
			H. P. Hubbard Middletown.	38.00	“
1798	Warranted No. 1 Peruvian Guano.	Hurtado & Co., 16 Exchange Place, New York	Southmayd & Gardiner, Middletown	....	“
			Wheeler & Howes, Bridgeport.	62.00	“
1772	Bradley's Fish and Potash, Triangle A Brand.	Bradley Fertilizer Co., 27 Kilby St., Boston.	Wheeler & Howes, Bridgeport.	31.-32.00	“
1767	Stearns' Fish and Potash, No. 1, Eagle Brand.	Stearns & Co., 124 Front St., New York.	A. R. Russell & Co., Meriden.	35.00	“
1660	Cecrops or Dragon's Tooth Fertilizer.	Newton & Ludlam, 182 Front St., New York.	S. Banks, Southport.	40.00	“
1780	Excelsior Guano.	E. Frank Coe, 16 Burling Slip, New York.	Arnold Rudd, New London.	42.00	“
1781	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass	A. B. Crandall, Tolland.	38.00	“
1822	Quinnipiac Extra Phosphate.	Quinnipiac Fertilizer Co., New London.	Coe & Marsh, Litchfield.	....	“
			Olds & Whipple, Hartford.	35.00	“
1676	E. F. Coe's High Grade Ammoniated Superphosphate.	E. Frank Coe, 16 Burling Slip, New York.	S. Banks, Southport.	34.00	“
			Arnold Rudd, New London.	35.00	“
			Strong & Backus, Colchester.	36.00	“
			J. B. Carpenter, West Willington.	36.00	“
1716	Bowker's Dissolved Bone.	Bowker Fertilizer Co., 43 Chatham St., Boston.	Jas. Greenfield, New London.	36.00	“
			Strong & Backus, Colchester.	36.00	“
			Seymour & Bonhite, Ridgefield.	40.00	“
1711	Quinnipiac Phosphate.	Quinnipiac Fertilizer Co., New London.	Usher & Tinker, Plainville.	40.00	“
			D. B. Judd, Bristol	40.00	

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.	Sampled by
1780	Great Planet Fertilizer, A Brand.	Clark's Cove Guano Co., New Bedford, Mass.	J. H. Ives, Danbury.	$47.00	Station Agent.
1818	Chittenden's Ammoniated Bone Superphosphate.	National Fertilizer Co., Bridgeport.	T. H. Eldredge, Norwich.	35.00	"
1849	Economical Bone Fertilizer.	Wilkinson & Co., 239 Center St., New York City.	Nelson Hanford, So. Wilton.	32.00	"
1714	Victor Phosphate, A 1.	Apothecaries' Hall, Waterbury.	Variety Store, Winsted.	35.00	"
			Apothecaries' Hall, Waterbury.	35.00	"
1777	Ammoniated Superphosphate.	Buffalo Fertilizer and Chemical Works, Buffalo, N. Y.	J. E. Leonard, Jewett City.	38.00	"
1677	Bradley's Superphosphate.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	A. C. Sternberg, Hartford.	38.00	"
			Chas. Jennings & Son, Southport.	40.00	"
			Usher & Tinker, Plainville.	40.00	"
			D. B. Judd & Co., Bristol.	40.00	"
			Strong & Backus, Colchester.	38.00	"
			Wm. D. Holman, West Willington.	38.00	"
1673	Quinnipiac Fish and Potash, Crossed Fishes Brand.	Quinnipiac Fertilizer Co., New London.	E. A. Godfrey, Westport.	38.00	"
			Olds & Whipple, Hartford.	38.00	"
			Usher & Tinker, Plainville.	38.00	"
1766	Fish and Potash.	Williams, Clark & Co., Hanover Square, New York.	E. M. Jennings, Southport.	34.00	"
1765	Original Coe's Superphosphate.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Wm. D. Holman, West Willington.	35.00	"
			Wheeler & Howes, Bridgeport.	- - - -	"
1662	Cereal Fertilizer.	Newton & Ludlam, New York.	S. Banks, Southport	$34.00	"
1675	Soluble Pacific Guano.	Soluble Pacific Guano Co., Boston, Mass.	Jas. Greenfield, New London	38.00	"
			J. B. Carpenter, West Willington.	36.00	"
			H. A. Stillman, Hartford.	36.-38.00	"

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.	Sampled by
1766	Fish and Potash.	Williams, Clark & Co., Hanover Square, New York.	E. M. Jennings, Southport	34.00	Station Agent.
1768	Circle Brand, Bone and Potash.	Wm. L. Bradley, Boston, Mass.	J. E. Leonard, Jewett City.	35.00	"
1773	B. D. Sea Fowl Guano.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	W. W. Cooper, Suffield.	38.00	"
1838	Fish and Potash, "Fish Brand."	John Guyer, New Haven, G. W. Miles, Agent.	Raymond Brothers, South Norwalk. G. L. Gage, Ridgefield.	36.00 40.00	" "
1663	Wilkinson & Co's Ammoniated Superphosphate.	Wilkinson & Co., 239 Center St., New York.	Ferris & Nolan, Stamford.	38.00	"
1749	Russel Coe's Ammoniated Bone Superphosphate.	Russel Coe Fertilizer Co., 88 Wall St., New York	S. J. Hall, Meriden. H. A. Stillman, Hartford.	34.00 32.–34.00	" "
1821	Quinnipiac Fish and Potash, Plain Brand.	Quinnipiac Fertilizer Co., New London.	D. B. Warner & Son, East Haddam. Usher & Tinker. Plainville. Olds & Whipple, Hartford.	32.50 33.00 34.00	" " "
1850	Bowker's Fish and Potash.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	H. K. Brainard, Thompsonville	33.00*	"
1664	Cook's Blood Guano.	Read & Co., 88 Wall St., New York.	Swan's Seed Store, Bridgeport.	37.–38.00	"
1790	Mitchell's Standard Superphosphate	A. Mitchell, Tremley Pt., Staten Is.	J. A. Lewis, Williamantic.	36.00	"
1784	Bowker's Fish and Potash.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Burtis & Mead, New Canaan. Seymour & Barhite, Ridgefield.	35.00* 38.00*	" "
1740	Common Sense Fertilizer, No. 2.	Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	D. Beers, Danbury. Jas. Greenfield, New London.	35.00 35.00	" "
1737	Charter Oak Fertilizer.	Paul Thomson, Hartford, Ct.	J. R. Cogswell, Putnam. B. B. Warner & Son, Plainville.	30.00 30.00	" "
1776	Common Sense Fertilizer, No. 3.	Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	Soule & Staub, New Milford.	40.00	"

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
												Available.							
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Found.	Guaranteed	Found.	Guaranteed.				
1791	Mapes' Fine Dissolved Bone.	----	----	2.38	2.38	2.1	5.17	11.99	2.02	19.18	----	17.16	12.0	----	----	----	$35.00	$35.56	----
1819	Quinnipiac Dry Ground Fish.	----	----	8.43	8.43	7.5	1.12	5.18	1.28	7.58	----	6.30	4.0	----	----	----	40.00	38.99	2.6
1768	Stearns' Pure Ground Fish Guano	----	----	8.53	8.53	7.8	1.08	4.24	1.81	7.13	----	5.32	----	----	----	----	40.00	38.63	3.2
1769	Acme Fertilizer, No. 2	----	4.66	1.39	6.05	5.0	6.99	1.65	.64	9.28	8.5	8.64	8.0	7.13	5.0	4.23	45.00	42.28	6.4
1745	Quinnipiac Phosphate	----	.82	3.44	4.26	2.7	7.21	3.48	.78	11.47	..	10.69	9.0	3.89	2.0	3.25	38.00	35.27	7.7
1799	Chittenden's Fish and Potash	----	.96	3.51	4.47	3.3	1.85	5.71	.94	8.50	6.0	7.56	----	5.32	5.0	4.57	35 00	32.08	9.1
1671	Quinnipiac Phosphate	----	1.73	1.25	2 98	2.5	7.56	4.81	.65	13.02	----	12.37	8.0	4.48	2.0	1.78	38.00	34.65	9.5
1748	Swift Sure Superphosphate	.47	----	2.34	2.81	2.5	10.24	2.40	.99	13.63	----	12.64	9.0	5.33	4.0*	trace	40.00	36.13	10.7
1770	Acme Fertilizer, No. 1	----	3.43	1.14	4.57	3.7	7.41	1.37	.58	9.36	8 5	8.78	----	10.01	9.0	----	45.00	40.05	12.3
1755	E. Frank Coe's Alkaline Bone	----	.22	1.84	2.06	.8	8.54	2.48	1.67	12.69	----	11.02	9.0	2.61	3.0*	.32	32.00	28.22	13.4
1728	Bosworth's Superphosphate of Lime	----	1.17	1.37	2.54	2.0	6.58	4.46	4.53	15.57	----	11.04	11.0	3.02	2.0	2.75	36.00	31.50	14.2
1736	Kelsey's Fish and Potash	----	.41	2.93	3.34	2.4	1.12	1.49	.22	2.83	3.0	2.61	----	3.29	3.0	----	21-21.50	18.44	15.3
1735	Mapes' Complete "A" Brand	.38	.51	2.17	3.06	2.4	6.98	5.20	1.98	14.16	----	12.18	10.0	3.31	2.5	4.72	38–40	33.64	15.9
1674	Mapes' Complete for General Use	.43	1.17	2.02	3.62	3.3	6.71	3.70	2.36	12.77	10.0	10.41	----	4.82	4.0	3.01	39–43	34.80	17.8
1679	Americus Superphosphate	----	.14	2.62	2.76	2.4	9.52	2 05	.81	12.38	11.0	11.57	----	2.94	2 0	.37	36–38	31.35	18.0
1797	Lister's Standard Phosphate	----	.60	1.75	2.35	2.3	8.93	2.46	.61	12.00	----	11.39	10.0	2.00	1.5	1.43	33–34	28.22	18.6
1737	Golden Leaf Fertilizer	----	2.92	.86	3 78	3.7	6.32	2.13	3.44	11.89	8.0	8.45	----	6.60	7.0	.81	42–44	36.08	19.2
1789	Lister's U. S. Superphosphate	----	.30	1.25	1.55	1.3	5.78	2.69	.69	9.16	----	8.47	6.0	3.09	2.0	6.51	26.00	21.69	19.9

* As Sulphate.

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed						
1795	Mapes' Complete for Light Soils	.71	2.55	2.45	5.71	4.9	4.50	3.91	1.21	9.62	7.0	8.41	....	6.96	6.0	5.29	$48.00	$40.10	20.2
1764	Pacific Guano Co's Fish and Potash	....	.30	2.59	2.89	2.4	5.42	1.98	2.38	9.78	6.0	7.40	....	4.45	4.0	5.66	30–35	26.77	21.4
1713	Bakers' A. A. Superphosphate	....	1.63	.87	2.50	2.4	10.91	.35	.03	11.39	....	11.26	10.0	3.02	2.0	3.85	35-37 50	29.56	22.6
1774	Bowker's Hill and Drill Phosphate	....	1.38	1.74	3.12	2.4	9.89	1.44	.70	12.03	11.0	11.33	....	1.57	2.0*	1.48	38.00	30.77	23.5
1729	Great Planet Fertilizer B.	2 63	2.04	1.18	5.85	5.0	5.24	.95	.27	6.46	....	6.19	5.0	7.47	7.0	2 44	48.00	38.67	24.1
1750	Pelican Bone Fertilizer	....	.69	2.21	2.90	1.8	7.69	.88	.04	8.61	....	8.57	8.0	2.91	2.2	5.88	32.50	26.17	24.2
1762	Stearns' Ammoniated Superphosphate	.53	....	2.36	2.89	2.3	7.14	2.67	1.13	10.94	....	9 81	8.0	3.81	2.0	4.53	35–38	29.33	24.5
1732	Market Bone Fertilizer	....	.50	3.03	3.53	3.0	4.29	4.86	.31	9.46	9.0	9.15	8.0	4.65	3.0	3.46	38.00	30.46	24.7
1782	Darling's Animal Fertilizer	.29	.41	3 12	3.82	3.3	1.93	4.87	5.11	11.91	10.0	6.80	....	5.21	4.0	6.62	38–40	31.10	25.4
1798	Warranted No. 1 Peruvian Guano	....	6.76	.84	7.60	7.4	1.91	8.25	4.09	14.25	12.0	10.16	....	3.42	2.0	1.65	62.00	48.96	26.6
1772	Bradley's Fish and Potash, Triangle A	....	.46	3.43	3.89	2.0	1.67	1.90	1.13	4.70	6.00	3.57	4.0	6.22	4.0	7.96	31–32	24.85	26.7
1767	Stearns' Fish and Potash, No. 1, Eagle Brand	....	....	3.07	3.07	2.4	3.04	3.77	4.00	10.81	8.0	6.81	3 0	5.01	1.7	7.29	35.00	27.62	26.7
1660	Cecrops or Dragon's Tooth Fertilizer	....	.95	2.41	3.36	3.3	6.51	1.01	.96	8.48	...	7.52	7.0	8.32	7.0	8.96	40.00	29	27

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Nitrogen					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed						
1780	Excelsior Guano	....	.95	2.72	3.67	3.3	8.36	1.46	1.23	11.05	10 0	9.82	....	3.11	5.0*	.59	$42.00	$32.29	30.0
1731	Bay State Fertilizer	....	.49	2.16	2.65	2.1	9.21	1.25	1.03	11.49	9 0	10.46	....	2.78	2.0	.89	38.00	29.15	30.3
1822	Quinnipiac Extra Phosphate	....	.36	2.45	2.81	2.3	5.78	3.67	.92	10.37	....	9.45	8.0	2.20	1.0	2.68	35.00	26.83	30.4
1676	E. F. Coe's High Grade Superphosphate	....	.59	1.60	2.19	2.1	8.00	2.07	1.99	12.06	....	10.07	9.0	1.79	2.0*	.12	34–36	26.65	31.3
1716	Bowker's Dissolved Bone	....	.30	1.81	2.11	2.0	9.43	1.97	.82	12.22	10.0	11·40	8.0	1.88	4.0*	4.55	36.00	27.40	31 4
1711	Quinnipiac Phosphate	....	.47	2.63	3.10	2.7	7.11	2.75	.44	10.30	....	9.86	9.0	2.72	2.0	4.25	38.00	28.75	32.1
1760	Royal Bone Phosphate	....	....	1.18	1.18	.8	6.52	2.88	.36	9.76	8.0	9.40	....	2.84	2.0	.56	29.00	21.92	32.3
1730	Great Planet Fertilizer A	...	1.92	1.92	3.84	3.3	7.09	.91	.64	8.64	....	8.00	7.0	10.02	9.5	6.78	47.00	35.49	32.4
1818	Chittenden's Ammoniated Superphosphate	....	.18	2.51	2.69	1.6	6.10	2.78	1.51	10.39	9.0	8.88	7.0	2.68	2.0	5.44	35.00	26.32	32.9
1849	Wilkinson's Econ'm'al Bone	....	1.91	.28	2.19	.8	5.61	1.66	1.27	8.54	6.0	7.27	....	4.48	2.0	11.11	32.0 0	24.06	33.0
1714	Victor Phosphate, A1	....	.18	2.06	2.24	2.3	8.32	1.43	1.10	10.85	....	9.75	8.5	2.28	3.5*	.09	35.00	26.27	33.2
1777	Buffalo Ammoniated Superphosphate	....	....	3.14	3.14	2.9	8.08	1.64	1.24	10.96	....	9.72	8.0	1.52	1.0	.56	38.00	28.30	34.2
1677	Bradley's Superphosphate	.13	.44	2.23	2.80	2.3	8.58	1.79	1.62	11.99	....	10.37	9.0	2.07	1.0	1.85	38–40	28.86	35.1
1673	Quinnipiac Fish and Potash, Crossed fishes brand	....	.55	3.20	3.75	3.3	2.02	3.39	1.46	6.87	5.0	5.41	....	6.90	3.0	5.58	38.00	27.98	35 8
1766	Williams, Clark & Co's Fish and Potash	....	.16	3.58	3.74	3.0	.36	4.32	2.49	7.17	6.0	4.68	....	4.36	4.0	8.58	34.00	25.02	35.9
1765	Original Coe's Superphos'ate	....	....	2.24	2.24	2.1	7.70	2.52	1.14	11.36	11.0	10.22	9.0	1.23	....	2.02	35.00	25 45	37.5
1662	Cereal Fertilizer	....	....	1.18	1.18	1.2	9 96	1.71	.72	12.39	12.0	11.67	10.0	2.06	4.0*	2.79	34.00	24 70	37.6

* As Sulphate.

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen. Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1675	Soluble Pacific Guano	....	.45	1.93	2.38	2.00	7.31	2.01	2.61	11.93	....	9.32	8.0	2.50	2.00	2.84	$36–38	$26.65	38.8
1766	Williams, Clark & Co's Fish and Potash	....	....	3.27	3.27	3.3	.40	5.35	1.48	7.23	3.00	5.75	....	4.26	3.0	8.73	34.00	24.30	39.9
1768	Circle Brand Bone and Potash	....	....	2.09	2.09	2.26	3.42	5.39	2.71	11.52	8.00	8.81	....	2.73	2.00	....	35.00	24.62	42.1
1772	B. D. Sea-Fowl Guano	....	.41	1.79	2.20	2.50	7.88	2.40	1.70	11.98	11.00	10.28	....	1.92	2.00	2.10	38.00	26.47	43.5
1838	Miles' Fish and Potash	....	....	2.53	2.53	2.5	6.15	2.17	1.47	9.79	....	8.32	5.0	2.73	4.0*	4.90	36.00	24.90	44.6
1662	Wilkinson's Ammoniated Superphosphate	....	....	2.09	2.09	1.7	7.58	1.31	.20	9.09	....	8.89	....	5.14	2.00	7.82	38.00	25.69	47.8
1749	Russel Coe's Ammoniated Bone Superphosphate	....	....	2.13	2.13	2.26	5.98	2.03	1.21	9.22	....	8.01	9.00	2.02	1.50	7.50	32–34	22.31	47.9
1821	Quinnipiac Fish and Potash, Plain Brand	....	.46	2.43	2.89	2.00	.44	3.95	2.01	6.40	6.00	4.39	4.00	5.46	4.00	6.47	32.50-34	22.42	48.3
1850	Bowker's Fish and Potash	....	.08	2.67	2.75	2.5	2.55	2.36	2.06	6.97	8.00	4.91	....	4.25	4.00	9.86	33.00	21.85	51.0
1664	Cook's Blood Guano	....	....	2.26	2.26	1.21	6.25	1.79	1.24	9.28	10.00	8.04	7.00	3.33	1.00	4.37	37–38	23.94	56.6
1790	Mitchell's Standard Superphosphate	....	....	1.12	1.12	2.06	7.36	3.46	.76	11.58	11.00	10.82	....	1.36	3.00	1.71	36.00	22.37	60.9
1784	Bowker's Fish and Potash	....	....	2.20	2.20	2.5	3.24	1.70	1.66	6.60	8.00	4.94	....	5.72	4.00	12.75	35.00	21.07	66.1
1740	Com Sense Fertilizer, No. 2	.71	.24	1.14	2.09	2.00	....	4.52	.73	5.25	4.00	4.52	...	4.93	3.00	4.67	35.00	18.80	86.1
1737	Charter Oak Fertilizer	1.94	.28	.77	2.99	1.65	trace	1.48	.77	2.25	2.25	1.48	....	2.65	2.00	...	30.00	15.77	90.2
1776	Com. Sense Fertilizer, No. 3	.91	none	.96	1.87	3.00	.19	2.76	2.01	4.96	5.00	2.95	....	4.15	3.00	3.70	40.00	15.80	153.1

FISH AND POTASH.

This brand of fertilizer has been a popular one in this State and for more ready comparison the several brands have been put by themselves on page 48, although they have been already tabulated with other ammoniated superphosphates. (For "Church's Fish and Potash D," see p. 37.)

Their average cost is $33.21, the average valuation is $24.78. The difference, $8.43 is 34 per cent. of the valuation. This shows that Fish and Potash this year, as in past years, has been relatively a more expensive fertilizer than other superphosphates.

The amount of phosphoric acid which these samples contain and the proportion of it that is insoluble shows that they are not all simple mixtures of pure fish scrap and potash salts as their name implies but contain more or less phosphate or superphosphate.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Manufacturers' Samples.

In the table on page 49 will be found analyses of certain samples deposited at the Station last spring by manufacturers, in accordance with the requirements of the Fertilizer Law, each sample being accompanied with a statement that it is a fair average of the brand. The agents of the Station not having found these brands on sale it became necessary to analyze the only samples available.

The guarantee of No. **1815**, Harris' Superphosphate of Bone, (4.0 per cent. of nitrogen and 25.0 per cent. of phosphoric acid) is evidently that of ground bone and not of superphosphate. It was however filed at the Station as the manufacturer's statement and is therefore reproduced here.

Samples drawn and sent by private parties.

In the table on page 50 are analyses of samples sent to this Station by private parties. In most of these cases the Station has no guarantee that the samples were fairly taken and therefore no valuations have been given. On samples sent by private parties, a considerable number of analyses have also been made which are worthless because it appeared after the analyses were done that the samples had been improperly taken or wrongly labeled and thus valuable time was wasted which was greatly needed on other work. It is to avoid such a waste as far as may be, in the time to come, that the Station has adopted the regulations in regard to gratuitous analyses which are printed on page 21 of this report.

Fish and Potash.—Sampled by the Station.

	Chittenden's.	Kelsey's.	Pacific Guano Co's.	Bradley's Triangle, A.	Stearns' No. 1 Eagle Brand.	Quinnipiac Crossed Fishes Brand.	Williams, Clark & Co's.	Williams, Clark & Co's.	Miles'.	Quinnipiac Plain Brand.	Bowker's.	Bowker's.
	1799	**1736**	**1764**	**1772**	**1767**	**1673**	**1766**	**1766a**	**1838**	**1281**	**1850**	**1782**
Nitrogen as Ammonia	.96	.41	.30	.46	....	.55	.16	....	...	.46	.08	....
Nitrogen, Organic	3.51	2.93	2.59	3.43	3.07	3.20	3.58	3.27	2.53	2.43	2.67	2.20
Soluble Phosphoric Acid	1.85	1.12	5.42	1.67	3.04	2.02	.36	.40	6.15	.44	2.55	3.24
Reverted Phosphoric Acid	5.71	1.49	1.98	1.90	3.77	3.39	4.32	5.35	2.17	3.95	2.36	1.70
Insoluble Phosphoric Acid	.94	.22	2.38	1.13	4.00	1.46	2.49	1.48	1.47	2.01	2.06	1.66
Potash	5.32	3.29	4.45	6.22	5.01	6.90	4.36	4.26	2.73	5.46	4.25	5.72
Cost	$35.00	$21-21.50	$30–35.	$31-32	$35.00	$38.00	$34.00	$34.00	$36.00	$32.50-34	$33.00	$35.00
Valuation	$32.08	$18.44	$26.77	$24.85	$27.62	$27.98	$25.02	$24.30	$24.90	$22.42	$12.85	$21.07
Nitrogen found	4.47	3.34	2.89	3.89	3.07	3.75	3.74	3.27	2.53	2.89	2.75	2.20
Nitrogen guaranteed	3.30	2.40	2.40	2.00	2.40	3.30	3.00	3.00	2.50	2.00	2.50	2.25
Phosphoric Acid found	8.50	2.83	9.78	4.70	10.81	6.87	7.17	7.23	9.79	6.40	6.97	6.60
Phosphoric Acid guaranteed	6.00	3.00	6.00	6.00	8.00	5.00	6.00	6.00	....	6.00	8.00	8.00
Potash found	5.32	3.29	4.45	6.22	5.01	6.90	4.36	4.26	2.73	5.46	4.25	5.72
Potash guaranteed	5.00	3.00	4.00	4.00	1.70	3.00	4.00	4.00	*4.00	4.00	4.00	4.00

Manufacturers' Samples of Superphosphates.

Station No.	Name or Brand.	Nitrogen in Nitrates.	Nitrogen in Ammonia.	Organic Nitrogen.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Phosphoric Acid.							Potash.		Chlorine.	Valuation per Ton.
							Soluble in Water.	Reverted.	Insoluble.	Total Phosphoric Acid.	Phos. Acid Guaranteed.	Available.		Found.	Guaranteed.		
												Found.	Guaranteed.				
1813	Bradley's Fish and Potash, Anchor Brand	....	.43	3.73	4.16	3.25	2.08	1.73	.69	4.50	5.00	3.81	3.00	4.31	3.00	9.15	$24.28
1842	Cook's Dissolved Ground Bone	....	....	....	....	....	9.46	3.43	.69	13.58	11.40	12.89	....	....	....	....	20.69
1817	Clark's Cove Guano Co's Unicorn Ammoniated Superphosphate	....	.11	1.90	2.01	1.80	5.68	3.32	2.96	11.96	10.00	9.00	8.50	3.22	2.25	1.45	25.76
1815	G. H. Harris & Son's Superphosphate of Bone	....	.56	1.58	2.14	4.00	5.88	....	.22	6.10	25.00	5.88	....	1.30	....	....	18.08
1862	G. W. Miles' Fish and Potash*	....	....	2.47	2.47	....	5.89	1.32	1.85	9.06	....	7.21	....	2.39	....	2.66	22.94
1666	G. W. Miller's Flour of Bone Phosphate	.75	....	1.81	2.56	....	1.12	10.24	.71	12.07	....	11.36	....	4.76	....	6.04	30.55
1839	Newton & Ludlam's Animal Bone	....	....	2.14	2.14	....	8.77	2.04	.93	11.74	....	10.81	....	1.77	....	4.42	26.44
1844	Preston's Ammoniated Bone Superphosphate	....	.24	2.64	2.88	2.40	7.13	2.47	2.28	11.88	....	9.60	9.00	.68	2.00	1.87	26.99

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* This sample was drawn from a lot of 400 bags at G. W. Miles' factory, by Station Agent.

SUPERPHOSPHATES SAMPLED BY PRIVATE INDIVIDUALS.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1829	Market Bone Fertilizer.	Adams & Thomas, Springfield, Mass.	Manufacturer.	Robt. Aitken, Shaker Station
1688	Bowker's Pure Dry Ground Fish.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Manufacturer.	M. S. Baldwin, Naugatuck.
1724	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain & Co., Fair Haven.	A. L. Chamberlain. Fair Haven.
1723	Unicorn Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain & Co., Fair Haven.	A. L. Chamberlain, Fair Haven.
1719	Special Quality Darling's Animal Fertilizer.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Earl Cooley, Berlin.	Earl Cooley, Berlin.
1856	G. W. Miles' Fish and Potash.	G. W. Miles, Milford.	C. H. Grant, Stafford.	C. H. Grant, Stafford.
1744	G. W. Miles' Fish and Potash.	G. W. Miles, Milford.	Manufacturer.	Clark W. Stowe, Milford.
1634	Chittenden's Complete Fertilizer.	National Fertilizer Co., Bridgeport.	G. Humphreyville, Thomast.	C. H. Cables, Thomaston.
1863	Chittenden's Complete Fertilizer.	National Fertilizer Co., Bridgeport.	J. S. Kirkham, Newington.	T. R. Atwood, Newington.
1628	Chittenden's Complete Fertilizer.	National Fertilizer Co., Bridgeport.	J. & F. Beach, Branford.	J. & F. Beach, Branford.
1864	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport.	J. S. Kirkham, Newington.	T. R. Atwood, Newington.
1681	Cereal Fertilizer.	Newton & Ludlam, New York City.	Manufacturer.	A. J. Briggs, Sherman.
1683	Cereal Fertilizer.	Newton & Ludlam, New York City.	Manufacturer.	A. J. Briggs, Sherman.
1706	Standard Superphosphate.	Standard Superphosphate Co., Duxbury, Mass.	Suffield Grange.	Allen Wilson, Suffield.
1619	Standard Superphosphate.	Standard Superphosphate Co., Duxbury, Mass.	Jas. Breck & Sons, Agents, Boston, Mass.	W. F. Andross, East Hartford.

ANALYSES OF SUPERPHOSPHATES SAMPLED BY PRIVATE INDIVIDUALS.

Station No.	Name or Brand.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic. Nitrogen	Total Nitrogen Found.	Nitrogen Guaranteed.	Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.
							Soluble in Water.	Reverted.	Insoluble.	Total Phosphoric Acid Found.	Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.		
												Found.	Guar-anteed.				
1829	Adams & Thomas' Market Bone Fertilizer	....	.48	3.18	3.66	3.15	4.50	4.52	.73	9.75	10.00	9.02	8.00	5.25	3.00	....	$38.00
1688	Bowker's Pure Dry Ground Fish	....	....	8.50	8.50	8.00	.88	4.38	2.59	7.85	....	5.26	....	....	....	....	†35.30
1724	Bay State Fertilizer	....	.78	1.69	2.47	2.10	9.71	.97	1.41	12.09	9.50	10.68	8.00	2.54	2.00	.64	40.00
1723	Unicorn Ammoniated Superphosphate	....	.21	1.84	2.05	1.80	7.44	2.40	2.23	12.07	10.00	9.84	8.50	2.76	2.25	.88	36.00
1719	Special Quality Darling's Animal Fertilizer	1.16	.43	2.84	4.43	3.29	4.62	4.78	1.78	11.18	10.00	9.40	....	5.97	4.00	5.19	40.00
1856	G. W. Miles' Fish and Potash	....	....	....	2.62	....	6.13	1.76	1.21	9.10	....	7.89	....	2.46	....	4.57	30.00
1744	G. W. Miles' Fish and Potash	....	.50	2.73	3.23	....	5.59	1.57	1.62	8.78	....	7.16	....	4.33	....	2.39	30.00
1634	Chittenden's Complete Fertilizer	....	1.44	3.24	4.68	3.30	6.69	3.33	.62	10.64	8.00	10.02	6.00	7.44	6.00	6.96	45.00
1863	Chittenden's Complete Fertilizer	....	1.72	2.81	4.53	3.30	5.20	2.72	2.44	10.36	8.00	7.92	....	7.22	6.00	6.15	45.00
1628	Chittenden's Complete Fertilizer	....	2.37	2.98	5.35	3.70	6.84	2.69	.60	10.13	8.00	9.53	6.00	6.20	6.00	....	45.00
1864	Chittenden's Fish and Potash	....	.60	4.52	5.12	3.30	2.56	3.47	1.69	7.72	6.00	6.03	....	6.29	5.00	5.62	35.00
1681	Newton & Ludlam's Cereal Fertilizer	....	....	2.09	2.09	1.20	9.15	1.24	1.16	11.55	12.00	10.39	....	1.31	*4.00	(?)	32.00
1683	Newton & Ludlam's Cereal Fertilizer	....	....	1.70	1.70	1.20	7.93	3.31	1.66	12.90	12.00	11.24	....	2.87	*4.00	(?)	32.00
1706	Standard Superphosphate	....	1.27	1.62	2.89	2.47	9.16	2.31	1.23	12.70	....	11.47	9.00	2.69	2.00	2.52	38.00
1619	Standard Superphosphate	....	....	2.85	2.85	2.47	7.65	2.13	1.58	12.36	11.00	9.78	9.00	2.51	2.00	....	38.00

* Sulphate. † In Naugatuck.

Spears' Perfect Fertilizer.

This article is said to have been sold in this State to
extent last year though no knowledge of it came to the St
It was carefully looked for this year but not found. A s
sent by the New England Homestead last spring had the f
ing composition:

Nitrogen	1.07
Phosphoric Acid	5.47
Potash	1.29
Sand and Silica	35.03
Carbonate of Lime	14.00

A liberal valuation would be $12.40 per ton. The cost i
to be $25.00 per ton.

Home-mixed Superphosphates.

The only sample of this class of goods which was sent
Station this year accompanied with statements of cost of
rials, formula by which it was compounded, etc., was from
Platt, Esq., of Milford. The formula was as follows:

5000 pounds dissolved bone black.
4000 pounds blood and bone.
2000 pounds muriate of potash.
1000 pounds sulphate of ammonia.

The cost of the materials was stated to be $30.00 pe
freight $2.00 and cost of mixing $1.00. The raw material
were separately analyzed and from those results the compo
which the mixture should have if made uniform and withou
is calculated and here compared with the analysis of the s
of the mixture itself sent by Mr. Platt.

	Mr. Platt's sample.	Calculat
Nitrogen as ammonia	1.87	1.68
Organic nitrogen	2.93	2.46
Soluble phosphoric acid	7.05	8.91
Reverted phosphoric acid	1.61	
Insoluble phosphoric acid	.94	
Potash	9.27	8.86
Cost per ton	$36.63	$33.00
Valuation per ton	$38.83	$34.98

The difference between the actual and the calculated co
tion though not inconsiderable is perhaps as little as cou

expected and for the most part doubtless resulted from loss of moisture out of the raw materials during the mixing or after. The proportion of the ingredients found indicates that the mixing was effectual and that the sampling was carefully done. The per cents. of fertilizing ingredients existing in the sample in every case exceed those calculated from the composition of the materials used. The extent to which the sample had been concentrated by drying may be reckoned approximately by the following proportions based on the ratios of the percentages in the sample to the percentages in the raw materials.

1.68 : 1.87 : : 100 : 111
2.46 : 2.93 : : 100 : 119
8.91 : 9.60 : : 100 : 108
8.86 : 9.27 : : 100 : 105

Average 111

It thus appears that 111 pounds of the mixed materials, as separately analyzed, had become reduced by drying, to 100 pounds as represented by the sample. Therefore 100 pounds of the sample should be compared as regards cost and valuation with 111 pounds of the materials used in mixing it. Mr. Platt's Home-mixed Superphosphate considered as 12,000 pounds of the raw materials in the state of dryness which obtained when they were analyzed, was worth six times $34.98, and if the materials originally were in the same state of dryness, cost six times $33.00. On the other hand, if the samples of the materials [dissolved bone-black, blood and bone, muriate of potash, and sulphate of ammonia] had lost moisture before they were analyzed, so that, say 111 pounds of the original materials were reduced to 100, then evidently it would be 2,220 pounds of them to which the valuation $33.00 should apply instead of 2000 pounds.

Again, this Home-made Superphosphate, as represented by the sample analyzed [Mr. Platt's sample] is a lot of 10,810 pounds, costing $36.63 and worth $38.83 per ton.

Mr. Platt purchased his materials direct from manufacturers and at the lowest market rates.

SPECIAL MANURES.

Samples drawn by Station agents.

The following table, pages 55 and 56 contains sixteen analyses of this class made on samples which are known to fairly repre-

sent the lots of goods from which they were taken. Of
brands there were several samples drawn in different place
the analysis was made on a mixture of equal weights of ea
these samples as has already been explained on page 34.

In the table are three analyses of the Quinnipiac P
Manure. It will be seen that **1672** represents the avera
three samples drawn in three different places: Bristol, Plai
and Hartford. These three samples looked alike and as
sequent chemical analysis proved were essentially alike in
position. The other two samples, **1746** and **1665**, which
drawn in Bridgeport and Westport, were very unlike the
above mentioned in appearance and for that reason wer
mixed with them but separately analyzed, and their sepa
from the others is justified by the analyses which are quit
similar. The manufacturer states that the first three sa
represent but a small fraction of the Potato Manure put o
Connecticut market this year, the larger part being shipp
the southern part of the State.—

Cost and valuation.—The average cost of these Special Ma
has been $42.56, the average valuation $36.70, and the diff
between cost and valuation $5.86 or 16 per cent. of the valu
The corresponding difference in the case of superphosphate
24.3 per cent. The special manures on the average are
priced, more concentrated and other things being equal,
economical to purchase.

SPECIAL MANURES.

Samples drawn by private parties.

The Station has no guarantee that the following sample
drawn in accordance with its instructions and therefore do
vouch for them or assign any valuation.

1720. Bradley's Complete Manure for Grass and Grai
Dressing.

1721. Bradley's Complete Manure for Potatoes and Veget

1722. Bradley's Complete Manure for Corn and Grass.

All of the above were manufactured by the Bradley Fer
Co., 27 Kilby street, Boston. They were sampled and se
L. H. Hall, Wallingford.

1865. Chittenden's Complete Fertilizer for Tobacco, ma
the National Fertilizer Co., Bridgeport, sampled by T.
wood from stock of J. S. Kirkham, Newington.

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per Ton.	Sampled by
1746	Quinnipiac Potato Manure.	Quinnipiac Fertilizer Co., N. London.	Berry & Sherman, Bridgeport.	$38.00	Station Agent.
1792	Mapes' Grass and Spring Top Dressing.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Mapes' Branch, Hartford.	45.00	"
1665	Quinnipiac Potato Manure.	Quinnipiac Fertilizer Co., N. London.	E. A. Godfrey, Westport.	38.00	"
1793	Mapes' Tobacco Manure, Conn. Brand.	Mapes' Formula and Peruvian Guano Co., New York.	Mapes' Branch, Hartford.	48.00	"
1796	Mapes' Corn Manure.	Mapes' Formula and Peruvian Guano Co., New York.	" "	44.00	"
			J. P. Barstow, Norwich.	44.00	"
1794	Mapes' Tobacco Manure for use with Stems.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	" "	48.00	"
1754	Potato, Hop and Tobacco Phosphate.	Buffalo Fertilizer and Chemical Works, Buffalo, N. Y	W. G. Staples, Westport.	39.00	"
1781	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co, 43 Chatham St., Boston, Mass.	J. A. Paine, Danielsonville.	45.00	"
			Seymour & Bonhite, Ridgefield.	45.00	"
			Brewster & Burnett, Norwich.	45.00	"
1752	H. J. Baker's Tobacco Fertilizer.	H. J. Baker & Bro.. 215 Pearl St, New York.	C. S. Smith, Kent, Ct.	45.00	"
1717	Mapes' Potato Manure.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Dean & Horton, Stamford.	48.00	"
			Birdsey & Foster, Meriden.	47.50	"
			Mapes's Branch, Hartford.	46.00	"
1761	Potato Phosphate.	Williams, Clark & Co., Hanover Square, New York.	J. P. Root, Tolland.	44.00	"
			E. M. Jennings, Southport.	44.00	"
1678	Stockbridge Vegetable Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	J. E. Leonard, Jewett City.	45.00	"
			Jas. Greenfield, New London.	45.00	"
			F. Ellsworth, Hartford.	45.00	"
1753	H. J. Baker's Corn Fertilizer.	H. J. Baker & Bro., 215 Pearl St., New York.	C. S. Smith, Kent.	45.00	"
1779	Stockbridge Grain Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston Mass.	Burtis & Mead, New Canaan.	45.00	"
1712	H. J. Baker's Potato Fertilizer.	H. J. Baker & Bro., 215 Pearl St., New York.	G. H. Alford, Winsted.	45.00	"
			W. W. Cooper, Suffield.	45.00	"
1672	Quinnipiac Potato Manure.	Quinnipiac Fertilizer Co., N. London.	Usher & Tinker, Plainville.	40.00	"
			D. B. Judd, Bristol.	40.00	"
			Olds & Whipple, Hartford.	40.00	"

ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1746	Quinnipiac Potato Manure	....	3.66	1.37	5.03	3.5	6.73	.70	.11	7.54	...	7.43	5.0	6.92	6.0	trace	$38.00	$37.69	.8
1792	Mapes' Grass and Grain Spring Top Dressing	.61	2.30	2.40	5.31	4.1	7.97	3.59	.73	12.29	7.0	11.56	....	7.82	5.0	7.10	45.00	44.16	1.9
1665	Quinnipiac Potato Manure	....	2.08	1.99	4.07	3 2	4.12	4.22	.81	9.15	....	8.34	5.0	6.92	6.0	.60	38.00	35.29	7.6
1793	Mapes' Tobacco Manure, Conn. Brand	.65	2.21	2.85	5.71	4.7	7.96	1.35	.38	9.69	7.7	9.31	....	8.08	7.7	.44	48.00	44.00	9.1
1796	Mapes' Corn Manure	.63	1.37	2.35	4.35	3.7	8.18	3.67	.69	12.54	10.0	11.85	....	6.62	6.0	5.39	44.00	40.03	9.9
1794	Mapes' Tobacco Manure for use with Stems	.29	3.55	2.06	5.90	5.3	8.20	2.80	.87	11.87	10.5	11.00	...	3.86	3.5	.47	48.00	43.13	11.3
1754	Potato, Hop and Tobacco Phosphate	....	....	3.05	3.05	2.0	8.52	2.56	.72	11.80	....	11.08	8.0	4.43	3.5	3.80	39.00	32.04	21.7
1781	Stockbridge Grass Top Dressing	....	3.01	2.30	5.31	5.5	8.23	1.18	.60	10.01	6.0	9.41	5.0	3.09	2.5	3.49	45.00	36.89	21.9
1752	H. J. Baker's Tobacco Fertilizer	....	3.80	1.37	5.17	4.5	4.06	1.17	.21	5.44	....	5.23	4.0	9.03	8.0	1.19	45.00	36.65	22.7
1717	Mapes' Potato Manure	.57	1.72	1.60	3.89	3.7	6 61	3.51	.98	11.10	8.0	10.12	....	7.39	6.0*	.62	46.48	38.27	22.8
1761	Williams, Clark & Co's Potato Phosphate	....	2.06	1.58	3.64	3.3	6.64	1.46	.31	8.41	7.0	8.10	....	8.42	15.0*	.49	44.00	35.09	25.4
1678	Stockbridge Vegetable Manure	....	1.19	2.06	3.25	3.3	10.32	1.71	.81	12.84	8.0	12.03	....	3.97	5.0	4.26	45.00	34.43	30.7
1758	H. J. Baker's Corn Fertilizer,	....	3.37	1.15	4 52	5.0	6.21	.63	trace	6.87	....	6.87	6.0	8.32	7.0	6.57	45.00	34.37	30.9
1779	Stockbridge Grain Manure	....	....	3.32	3.32	3.7	9.54	1.14	1.17	11.85	7.0	10.68	6.0	5.88	4.0	6.16	45.00	33.96	32.5
1712	H. J. Baker's Potato Fertil-																		

ANALYSES.—See page 4.

	1720	1721	1722	1865
Nitrogen as nitrates	3.45	----	.43	----
Nitrogen as ammonia	----	1.13	1.98	----
Organic nitrogen	.38	3.04	2.69	2.69
Soluble phosphoric acid	6.22	9.70	8.61	6.68
Reverted phosphoric acid	.96	.33	.14	2.69
Insoluble phosphoric acid	.62	.13	.13	1.75
Potash	6.06	6.65	8.91	5.77
Chlorine	2.30	trace	trace	.58
Cost	$45.00	45.00	45.00	45.00

BONE MANURES.

Samples drawn by Station Agents.

(See tables of analyses, pages 58 and 59).

Leaving out of account two exceptional articles, namely: E. F. Coe's Bone and Green's Common Bone, the average cost of the fourteen genuine samples is $36.14 and the average valuation, $38.24, about two dollars higher. The valuation of bone is designed to correspond approximately with the average selling price through the State. This year apparently it has slightly exceeded it. The method of valuation of bone fertilizers which must necessarily be based upon their degree of fineness as well as upon their chemical composition is fully explained on page 29.

Some of the analyses require special notice. Nos. 1733, Peter Cooper's Bone Dust and 1657, Green's Pure Fine Bone Dust, are bone from which the nitrogenous matter has been largely extracted probably in the manufacture of glue. Because of the removal of this nitrogenous matter the bone is relatively richer in phosphoric acid. No. 1747, Shoemaker's Swift Sure Bone Meal, has been quite perfectly freed from grease, the manufacturer having extracted it with benzine by a patented process. No. 1655, Lister's Celebrated Ground Bone, contains salt-cake which is added as a preservative. The bone has the full guaranteed amount of nitrogen and phosphoric acid. No. 1654, E. F. Coe's Ground Bone, is a mixture of bone and potash salts. No. 1656, Green's Common Bone, was found on sale in Southport. It is a mixture of some bone with oyster shells or other form of carbonate of lime and also contains 25 per cent. of water. Its cost was $25.00 or nearly twice its value. It was offered for sale without any guarantee.

BONE MANURES.—SAMPLED BY STATION.

Station No.	Name or Brand.	Manufacturer.	Dealers.	Cost per ton.	Sampled and sent by
1733	Peter Cooper's Pure Bone Dust.	Peter Cooper's Glue Factory, 16 Burling Slip, New York City.	Apothecaries Hall, Waterbury.	$32.00	Station Agent.
			Brewster & Burnett, Norwich.	34.00	" "
1727	Bosworth's Ground Bone.	Bosworth Bros., Putnam, Ct.	Manufacturers.	34.00	" "
1747	Shoemaker's Swift Sure Bone Meal.	M. L. Shoemaker & Co., Philadelphia, Penn.	J. P. Barstow, Norwich.	41.00	" "
			F. Ellsworth, Hartford.	43.00	" "
1670	Americus Brand Pure Bone Meal.	Williams, Clark & Co., Hanover Sq., New York.	Strong & Backus, Colchester.	36.00	" "
			Usher & Tinker, Plainville.	38.00	" "
			E. M. Jennings, Southport.	38.00	" "
1657	Jas. Green's Pure Fine Bone Dust.	Jas. Green, New York City.	Chas. Jennings & Son, Southport.	32.00	" "
1820	Rogers & Hubbard Co's Pure Ground Bone, Grade AX.	Rogers & Hubbard Co., Middletown.	Wilson & Burr, Middletown.	34.00	" "
1775	L. B. Darling's Fine Ground Bone.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	W. W. Cooper, Suffield.	41.00	" "
1778	Buffalo Fertilizer Co's Pure Ground Bone.	Buffalo Fertilizer and Chemical Works, Buffalo, N. Y.	J. E. Leonard, Jewett City.	38.00	" "
1653	Quinnipiac Bone Meal.	Quinnipiac Fertilizer Co., New London.	E. A. Godfrey, Westport.	38.00	" "
1837	Ground Raw Knuckle Bone, Grade Meal.	Rogers & Hubbard Co., Middletown.	Southmayd & Gardiner, Middletown.	39.00	" "
1718	Pure Raw Knuckle Bone, Grade "A," Extra Fine.	Rogers & Hubbard Co., Middletown.	J. P. Barstow, Norwich.	38.00	" "
			S. J. Hall, Meriden.	38.00	" "
			Strong & Backus, Colchester.	37.00	" "
1739	Peck Bro's Pure Ground Bone.	Peck Bros., Northfield, Ct.	Apothecaries Hall, Waterbury.	35.00	" "
1655	Lister's Celebrated Ground Bone.	Lister Bros., Newark, N. J.	W. G. Staples, Westport.	29.00	" "
1783	Darling's Ground Bone, Eagle Brand.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Olds & Whipple, Hartford.	40.00	" "
			W. W. Cooper, Suffield.	36.00	" "

ANALYSES OF BONE MANURES.—SAMPLED BY STATION.

Station No.,	Name or Brand.	Nitrogen.	Phos. Acid.	Potash.	Finer than				Coarser than $\frac{1}{6}$ inch.	Cost per ton.	Valuation per ton.	Percent'ge difference between cost and valuation.
					$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{6}$ inch.				
1733	Peter Cooper's Pure Bone Dust	1.61	30.64	....	53	15	20	12	--	$32–34	$42.22	....
1727	Bosworth's Ground Bone	4.30	21.88	....	71	21	6	2	--	34.00	42.88	....
1747	Shoemaker's Swift Sure Bone Meal	6.45	19.95	....	71	23	6	--	--	41–43	47.56	....
1670	Americus Brand Pure Bone Meal	4.31	19.40	....	56	23	19	2	--	36–38	38.06	....
1657	Jas. Green's Pure Fine Bone Dust	1.16	26.45	....	47	22	16	11	4	32.00	35.05	....
1820	Rogers & Hubbard's Pure Ground Bone, Grade AX	4.26	20.36	....	37	24	33	6	--	34.00	36.74	....
1775	L. B. Darling's Fine Ground Bone	2.59	25.95	....	62	25	13	--	--	40.00	41.96	....
1778	Buffalo Fertilizer Co's Pure Ground Bone	3.87	21.80	....	58	22	16	4	--	38.00	39.78	....
1653	Quinnipiac Bone Meal	4.22	22.93	....	33	24	40	3	--	38.00	39.36	....
1837	Ground Raw Knuckle Bone, Grade Meal	3.93	24.72	....	28	22	50	--	--	39.00	40 02	....
1718	Pure Raw Knuckle Bone, Grade "A" Ex. Fine	3.96	25.18	....	23	18	33	26	--	37–38	37.99	....
1739	Peck Bro's. Pure Ground Bone	4.12	20.92	....	21	20	33	22	4	35.00	33.50	4.5
1655	Lister's Celebrated Ground Bone	3.50	14.12	....	35	22	28	15	--	29.00	26.47	9.5
1783	Darling's Ground Bone, Eagle Brand	2.79	21.22	....	40	28	22	10	--	36–40	33.73	12.7
1654	E. Frank Coe's Ground Bone	2.95	12.11	2.13	48	18	16	10	8	28.00	24.62	13.7
1656	Jas. Green's Common Bone	1.97	7 78	....	26	15	16	19	24	25.00	12.90	93.8

ANALYSES OF MANUFACTURERS' SAMPLES OF BONE MANURES.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than				Coarser than $\frac{1}{6}$ inch.	Valuation per ton.	Cost per Ton.
				$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch	$\frac{1}{6}$ inch.			
1814	P. W. Bennett's Ground Bone	3.32	24.66	16	14	33	36	1	$33.79	Not stated.
1816	G. H. Harris & Son's Ground Bone	4.15	19.61	5	9	16	32	38	25.43	" "
1843	National Fertilizer Co's Fine Animal Bone	6.28	16.94	51	19	17	13	..	39.64	" "
1845	Preston Fertilizer Co's Ground Bone	3.62	9.84	33	26	20	11	10	21.33	" "
1846	E. Smith's Ground Bone	4.10	21.53	31	29	24	16	..	36.65	" "

BONE MANURES.—SAMPLED BY PRIVATE INDIVIDUALS.

Description of Samples.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
1651	H. J. Baker's Strictly Pure Bone	H. J. Baker & Bro., 215 Pearl st., New York City	J. J. Alvord, Green's Farms	John H. Jennings, Green's Farms
1618	Howard Co's Pure Bone	Howard Co, New York City		Chas. Fairchild, Middletown
1650	Williams, Clark & Co's Americus Brand Pure Bone Meal	Williams, Clark & Co., Hanover Square, New York	E. M. Jennings, Green's Farms	John H. Jennings, Green's Farms

Analyses and Valuations.

Station No.	Name or Brand.	Nitrogen.	Phos. Acid.	Finer than				Coarser than $\frac{1}{6}$ inch.	Cost per ton.
				$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{6}$ inch.		
1651	H. J. Baker's Strictly Pure Bone	3.80	19.38	61	38	1			$35.00

A Statement.

Early in the last season the Station received from two different parties in one town, samples of a bone manure with the usual guaranteed analysis and costing $35.00 per ton. Analysis showed the bone to be of poor quality, mixed with salt cake and not worth more than $20.00 per ton. The results were reported as usual both to the seller and the purchasers. The seller at once came to the Station and stated that the bone had been purchased by him for his private use at a low figure and stored temporarily for convenience in his warehouse; that his shipping clerk, perhaps by mistake, had shipped this bone instead of his regular article to these two customers; that the clerk had been discharged and that he, the seller, had offered to make any settlement with the purchasers which would suit them. He further represented that the publication of these analyses would greatly and unjustly damage his business and requested that they be withheld. The Station corresponded with the two purchasers, both of whom expressed themselves as not caring to have the analyses published. It was therefore decided to withhold the analyses from publication if no further instances of the kind should be brought to our notice.

Cotton Seed Meal.

1691. Cotton Seed Meal sampled by Station Agent from stock of Olds & Whipple, Hartford:

ANALYSIS.

Nitrogen	7 29
Phosphoric Acid	1.84
Potash	2.17
Cost per ton	$25.00
Valuation per ton	$29.21

Cotton Seed Meal is considerably used as a fertilizer in the tobacco growing region of this State, and to some extent as cattle food. It is one of the most concentrated of our cattle foods, and excessive use of it is injurious to cattle, while an amount that does not seriously injure cows is believed to affect the flavor of butter unfavorably. Rationally used, however, it is one of the cheapest and best cattle foods, and as the analysis shows, has a higher manurial value than any other.

Castor Pomace.

1715. Castor Pomace made by H. J. Baker and Bro., N
A mixture of two samples drawn in May last, one from six
in a stock of sixty bags, at New Milford; the other from
bags in a stock of one hundred and fifty bags at Usher & Tink
Plainville. Sampled by Station Agent.

1823. H. J. Baker's Castor Pomace. Sample drawn Aug
from one bag by Buckland & Hardin, of Glastonbury, and
yzed at request of manufacturers.

1734. Castor Pomace made by Collier White Lead and
Co., St. Louis, Mo. A mixture of two samples drawn by Sta
Agent early in May last. One sample from eight bags in a stoc
eighty bags at F. Ellsworth's, the other from four bags
stock of fifty bags at Olds and Whipple's, both of Hartford.

1824. Collier Castor Pomace. Sample drawn by Sta
Agent Aug. 4th, from fourteen bags in a stock of about
hundred and fifty bags at F. Ellsworth's.

1785. Collier Castor Pomace. A sample drawn from one
by W. F. Andross, East Hartford, in July last.

Analysis and Valuations.

	1715	1823	1734	1824
Water	9.23	9.13	8.83	9.34
Organic and volatile matters	84.93	85.53	82.74	83.70
Ash	5.84	5.34	8.43	6.96
	100.00	100.00	100.00	100.00
Insoluble in acids	1.10	.34	3.11	1.98
Nitrogen	4.76	4.48	5.54	4.99
Phosphoric Acid	1.46	1.54	1.86	1.42
Potash	.95	.93	1.07	1.07
Cost per ton	$24.00	19.00	20.00	19.00
Valuation per ton	$19.03	18.18	23.45	19.87

Both brands of Pomace are inferior in quality to the sampl
the same brands analyzed last year and the year before. In
opinion of the manufacturers this is due to the fact that, owin
an insufficient supply of domestic seed, some foreign seed has
used which is not so clean nor of as good quality as the dome
The samples of Collier Pomace contain some sand, and
and **1785** contain besides small fragments of quartz and
stone, which the manufacturers state came in the Calcutta

and were not noticed by them till they appeared in the pomace. Steps are said to have been taken to remove this foreign matter by screens before crushing the seed. The reduction in the per cent. of nitrogen, due to the presence of 5 per cent. of sand, etc., would be about 0.30 per cent.

NITRATE OF SODA.

1833. Sampled by Station Agent from stock of Mapes' Branch, Hartford.

1835. A mixture of two samples of nitrate. One is from the stock of Olds and Whipple, Hartford; price, $3.15 per 100 pounds. The other from stock of Wilson and Burr, Middletown; price, $56 per ton. The nitrate at both places was from the Quinnipiac Fertilizer Co., New London, and the samples were drawn by Station agents.

1840. From stock of the Rogers and Hubbard Co., Middletown. Manufacturer's sample.

1758. From stock of Wilson and Burr, Middletown. Sampled by M. E. Parmelee, Killingworth.

ANALYSIS.

	1833	1835*	1840	1758
Nitrogen	16.06	15.95	16.09	16.06
Equivalent Nitrate of Soda	97.52	96.88	97.69	97.48
Chlorine	.35	.31	.30	....
Sulphuric Acid	.15	.22	.11	....
Moisture	1.63	2.22	1.61	....
Cost per ton	$63.00	56.00 & 63.00		57.00
Nitrogen costs per pound	19.6 cts.	17.5 & 19.7 cts.		17.7 cts.

* Mixture of two samples, hence two prices are given.

SULPHATE OF AMMONIA.

1832. From the Mapes' Branch, Hartford. Sampled by Station Agent.

1685. From the Bowker Fertilizer Co., Boston. Sampled and sent by M. S. Baldwin, Naugatuck.

1786. From C. Meyer, Jr. Sampled and sent by M. S. Baldwin, Naugatuck.

1627. From C. Meyer, Jr., Maspeth, Long Island. Sampled by Station Agent from stock purchased by J. J. Webb, Hamden.

1643. From C. Meyer, Jr. Sampled and sent by G. F. Platt, Milford.

SULPHATE OF AMMONIA.

	1832	1685	1786	1627	1
Nitrogen	19.93	20.86	20.81	20.09	20
Equivalent to Ammonia	24.20	25.33	25.27	24.50	24
Cost per ton	$78.00	70.00	72.82	----	-
Nitrogen costs per pound	19.5 cts.	16.8 cts.*	17.4 cts.	----	-

* In N. Y.

POTASH SALTS.

Sulphate of Potash.

1686. Sampled and sent by M. S. Baldwin, Naugatuck. F lot purchased of the Bowker Fertilizer Co., N. Y.

1788. Sampled and sent by M. S. Baldwin, Naugatuck. F lot purchased of C. Meyer, Jr., Maspeth, Long Island.

Both the above are double sulphate of potash and magnesi "manure salt."

Muriates.

1831. From stock of Mapes Branch, Hartford.

1834. Sold by the Quinnipiac Fertilizer Co., New Lon From stock of Wilson and Burr, Middletown.

1836. Sold by Williams and Clark, N. Y. From stock M. Jennings, Southport.

1624. From lot purchased by J. J. Webb, Hamden.

The above were sampled by the Station Agent.

1841. Stock sold by Rogers and Hubbard Co., Middlet Sampled by the dealers.

1642. Sampled by G. F. Platt, Milford, from stock purch of C. Meyer, Jr., Maspeth, L. I.

1787. Sampled by M. S. Baldwin, Naugatuck, from stock chased of C. Meyer, Jr.

1757. Sampled by M. E. Parmelee, Killingworth, from s of the Rogers and Hubbard Co., Middletown.

1759. Sampled by M. E. Parmelee, from stock of Wilson Burr, Middletown.

	1686	1788	1831	1834	1836	1624	1841	1642	1787	175
Potash	23.61	23.21	49.16	48.24	52.32	51.66	52.66	53.46	52.12	54.
Equivalent Muriate of Potash	----	----	77.9	76.4	82.9	81.9	83.4	84.6	82.03	86.
Equivalent Sulphate of Potash	43.6	41.9	----	----	----	----	----	----	----	--
Cost per ton	$37.30*	----	45.00	42.50	45.00	----	----	----	45.70*	42.
Potash costs per pound	cts. 7.9	----	cts. 4½	cts. 4.4	cts. 4.3	----	----	----	cts. 4.38	cts 3.

* In Naugatuck.

Following is a complete analysis of a sample of muriate of potash drawn by C. P. Augur, Whitneyville, from stock purchased from R. B. Bradley & Co., New Haven.

Potash*	52.43
Soda	5.38
Lime	.53
Magnesia	1.77
Chlorine	44.87
Sulphuric Acid	3.38
Insoluble in water	.65
Water, Carbonic Acid and loss	1.10
	110.11
Deduct Oxygen equivalent to Chlorine	10.11
	100.00

* The equivalent muriate of potash is 82.99 per cent.

COTTON HULL ASHES.

1667. Very light colored. **1669.** Dark Colored. Both from stock of W. W. Cooper, Suffield. Sampled and sent by F. B. Hatheway, Windsor Locks.

1594. Light colored ashes, **1593,** medium shade, **1595** dark colored ashes, from Ariel Mitchelson, Tariffville.

1668. Fine ground cotton hull ashes, stock of R. E. Pinney, Suffield, sampled by F. B. Hatheway, Windsor Locks. This sample represents stock which had been ground in a mill to make it fine and uniform.

1632. From stock of R. A. Parker, Warehouse Point, sampled and sent by George Watson, Warehouse Point.

1648. From stock of R. A. Parker, sampled and sent by him. From same lot of 1½ tons as **1632.**

1649. From stock of R. A. Parker, sampled and sent by J. B. Noble, East Windsor Hill.

1700. From Stock of Olds & Whipple, Hartford, sampled and sent by E. N. Welch, Forestville.

1690. From stock of W. W. Cooper, Suffield, received by him from Olds & Whipple, Hartford, sampled by Station agent.

The analyses represent the variations in quality which occur in Cotton Hull Ashes in the Connecticut market. The first five analyses illustrate the fact to which attention has been repeatedly called that ashes of light color are richer in potash than dark colored ashes. The ashes as received from the south are not unifor quality. The contents of actual potash in different bags varies five to ten per cent. To insure a fair sample at least of the stock must be worked over and thoroughly mixed.

Cotton Hull Ashes.—Analyses and Valuations.

	1667.	1669.	1594.	1593.	1595.	1668.	1632.	1648.	1649.	17
Soluble phosphoric acid			.17	.56	2.57	1.70	.90	.74	.93	4
Reverted phosphoric acid	5.68	10.77	5.60	4.88	4.31	9.78	5.16	5.46	8.19	20
Insoluble phosphoric acid			.16	.29	1.50	.94	1.10	1.02	.59	1
Potash soluble in water	27.81	22.08	28.54	26.34	20.59	24.46	12.78	14.55	23.97	10
Cost per ton	$35.00	35.00				35.00	35.00		35.00	
Valuation per ton	$30.59	24.29	40.12	37.31	33.83	44.86	23.67	25.77	40.39	4

Below are given the average composition of Cotton Hull as well as the maximum and minimum figures, derived fr analyses which have been made at this Station.

	Minimum.	Maximum.
Phosphoric acid soluble in water	.17	2.57*
" " " ammonium citrate	4.18	9.78*
" " only soluble in acid	.16	3.34
Potash soluble in water	12.78	32.52

* Omitting No. **1700.**

Unleached Wood Ashes.

1592. Hard wood ashes sent by C. W. Barbour, Kensi cost, 12.50 per ton.

1633. From Charles Stevens, Napanee, Canada, guarant contain 7 per cent. of potash, sampled and sent by C. B. M Westport.

1699. From James Hartness, Detroit, Mich., sampled an by N. S. Pratt, Cheshire. Cost, 21 cents per bushel of 40 p delivered in Cheshire.

Analyses.

	1592.	1633.	169
Potash soluble in water	7.26	4.17	5.5
Phosphoric acid	1.73	1.39	1.3
Sand and insoluble matters	----	----	14.9
Water	----	----	15.2

Unleached Canada ashes of average quality contain 5.7 per cent. of potash and 1.2 per cent. of phosphoric acid. Ashes made largely from our hard woods are somewhat richer both in phosphoric acid and potash.

LEACHED CANADA ASHES.

1647. Stock of Nelson Alvord, Southport. Sampled and sent by W. H. Burr, Westport.

1829. Stock of Isaac Wardwell, New Canaan. Sampled and sent by C. F. Olmstead, master New Canaan grange. Cost 17 cents per bushel by the car load.

1848. Stock of Horace C. Bristol, Cheshire. Cost, $5.50 per ton. Sampled and sent by S. A. Smith, Cheshire.

ANALYSES.

	1647.	1829.	1848.
Water	24.05	33.90	33.89
Insoluble matters	25.25*	15.98	16.37
Potash	.54	.83	1.13
Phosphoric acid	1.36	1.28	1.36

* Mostly broken crockery, glass and nails.

The average composition of leached ashes as well as the maximum and minimum figures, derived from twelve analyses formerly made at this Station is as follows :

	Minimum.	Maximum.	Average.
Potash	.54	1.54	1.12
Soda	.48	1.30	.67
Lime	24.37	34.65	28.46
Magnesia	2.10	3.22	2.69
Oxide of iron	.82	4.16	2.07
Phosphoric acid	.88	2.12	1.47
Sulphuric acid	.10	.20	.11
Water	24.05	39.65	31.09
Carbonic acid	14.99	23.90	14.66
Insoluble matter—sand, coal, etc.	7.62	25.25	13.79
Undetermined and loss			3.87
			100.00

The value of ashes is not exclusively or chiefly in the phosphoric acid and potash which they contain. Their action on the soil is largely indirect—as an amendment. The determinations of pot-

ash and phosphoric acid serve to show however whether the
ple is of the usual quality.

TOBACCO STEMS.

1867. A sample of Tobacco Stems taken from a bale
given to the Station for the purpose by F. Ellsworth, Ha
The bale was selected by a Station Agent from a cargo
in New Haven *en route* to Hartford, and was pulled to pi
secure a perfectly satisfactory sample of the whole.

ANALYSIS.

	1867
Water	19.8
Organic and volatile matters*	63.3
Potash	7.6
Soda	.1
Lime	4.2
Magnesia	.8
Oxide of iron	.2
Sulphuric acid	.4
Phosphoric acid	.7
Chlorine	.2
Soluble Silica	.6
Sand	1.6
	100.0

* Containing Nitrogen, 1.96.

The cost of Tobacco Stems has been from $10.50 to $12.
ton during the year.

STAR FISH.

Star fish which are the most destructive pest of the oyste
on our coast are brought ashore in considerable quantity by
that are engaged in removing them by dredges from the
They have been composted and used as manure to some
The following analysis was made on Star fish kindly suppl
J. and G. H. Smith, 150 Long Wharf, New Haven.

The Stars were taken immediately after being landed.
comparison the analysis of horse manure of average qua
also given.

	Star Fish.	Horse Manure.
Water	68.78	71.30
Organic matter	15.13	25.40
Containing nitrogen	[1.72]	[.58]
Ash	16.09	3.30
	100.00	100.00

The ash contains—

Potash	.48	.54
Soda	.31	.10
Lime	7.22	.21
Magnesia	.63	.14
Oxide of iron	.12	.11
Phosphoric acid	.25	.28
Sulphuric "	.32	.07
Carbonic "	5.81	--
Chlorine	.47	.04
Sand and silica	.59	1.21
	16.20	3.25
Deduct oxygen equivalent to chlorine	.11	
	16.09	

The analyses indicate that the fresh star fish contain about as much phosphoric acid and potash and three times as much nitrogen as average horse manure. The percentage of water is not very different. Horse manure contains 10 per cent. more of organic matter which on some lands has considerable value as an amendment, while the Star fish supply about 12 per cent. of useful carbonate of lime. The organic matter of the Star fish rapidly liquifies and decays and its nitrogen quickly becomes available as plant food. The organic matter of horse manure is largely vegetable fiber that has resisted digestion and requires considerable time to decay away. The nitrogen of horse manure is accordingly much less rapidly effective though more durable in its action than that of the Star fish.

HEN MANURE.

A sample of hen manure was sent to the Station by Hon. T. S. Gold, with the following explanations: "The sample of hen manure was supposed to represent the common article as it is found among farmers. The fowls occupied two places, one quite dry, the other a basement quite damp. It was put in barrel exposed to a moderate rain, imperfectly covered or entirel covered, but there was not sufficient wet to cause leaching. whole lot, five barrels, estimated at half a ton, was thoro mixed in a cart and sampled. The rain accounts for the per cent. of water, and while it reduces its value per ton, di injure its total value, as it was used soon and did not heat. number of fowls varied, but averaged about forty, besides ens. They were only partially confined to their yards, but than they are ordinarily. I hope you will examine a s furnished by some of the poultry men. Let the weight be of the whole product for the year from a flock confined to quarters. This sample represents what the farmer may fi an ordinary result where his poultry are not entirely confine

The Station will be glad to analyze a sample taken in th that Mr. Gold has described. Following is the result o analysis made on the sample sent by **Mr. Gold**:

Water	56.62
Organic and volatile matters	16.57
[Containing nitrogen as ammonia, .82; Organic nitrogen, .56; Total nitrogen	1.38]
Ash or mineral matter	26.81
	100.00

The ash contains:

Potash	.69
Soda	.31
Lime	2.10
Magnesia	.99
Oxide of iron	1.29
Phosphoric acid	.84
Sulphuric acid	.38
Chlorine	.06
Sand and earth	20.15
	26.81

PEAT AND SWAMP MUCK.

1604. Dried Peat Dust. Prepared and sent to the S by Dennis Tuttle of New Haven.

1830. Swamp Muck sent by T. D. Barclay, Centerbroo

1847. Swamp Muck sent by Elijah Woodward, Torrin

ANALYSES OF SWAMP MUCK.

	1604	**1830**	**1847**
Water	13.60	59.90	59.72
Organic and volatile matters	68.08	10.80	9.06
[Containing nitrogen	1.43	.51	.25]
Ash	18.32	29.30	31.22
	100.00	100.00	100.00

In the ash are contained :

Matters insoluble in acid	14.82	26.38	27.40
Oxide of iron	1.32		1.20
Lime	.40	.49	.46
Magnesia		.20	
Phosphoric acid	.13	.22	.08
Other matters	1.65	2.01	2.08
	18.32	29.30	31.22

The dry material contains:

Organic and volatile matter	78.82	27.10	22.46
[Containing nitrogen	1.65	1.27	.62]
Ash	21.18	72.90	77.54
	100.00	100.00	100.00

The ash reckoned on dry matter contains:

Matters insoluble in acid	17.14	65.75	67.95
Oxide of iron	1.52		2.97
Lime	.46	1.24	1.14
Magnesia		.50	
Phosphoric acid	.15	.55	.20
Other matters	1.91	4.86	5.28
	21.18	72.90	77.54

DEPOSIT UNDERLYING PEAT.

1866. Sent by S. B. Belden, Springdale, who writes that it occurs under peat in a swamp, does not burn, but turns white when heated and can then be sawed into excellent crayons for the blackboard. The sample contained:

	1866
Water and organic matter	21.23
Matters soluble in acid	3.08
Silica	75.69
	100.00

The silica is chiefly "infusorial silica" which consists skeletons of a low order of aquatic vegetable growth. free from sand it makes an excellent polishing powder.

SALT.

A sample of salt produced in the manufacture of saltpet sent by Harvey Elliott of North Guilford, had the foll composition:

Water	5.77
Muriate of potash	1.49
Salt	90.19
Sulphates of lime and magnesia	2.55
	100.00

The actual potash present was .96 per cent. There was mere trace of nitric acid.

REVIEW OF THE FERTILIZER MARKET.*

NITROGEN.

Nitrogen of Organic Matters.

In dried blood at wholesale nitrogen was quoted in New at about 14.1 cents per pound from the first of December, till the last of February following. During March and A sold at 14.9 cents, declined in May to 14.6, and in June cents per pound, which was the lowest figure reached duri year. Since then it has remained quite steady at 14 to 14. per pound.

In Azotin the New York *wholesale price* of nitrogen wa cents in December, 1885. It rose steadily to 14.8 cents in and 15.6 cents in April. It then declined steadily to 14. in July where it has remained ever since.

Dry Ground Fish was quoted at $29 per ton till May an then no quotations have been given. At that price the sale cost of nitrogen in this material would be about 13 ce pound.

Taking the year through the wholesale cost of nitrogen articles above-named has been about 14.6 cents per pound.

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* For the year ending December 1st, 1886.

In the form of Cotton Seed Meal and Castor Pomace, organic nitrogen has sold at retail in this State during the year for from 14.1 to 22.2 cents per pound. The average has been 17.1 cents.

Nitrogen of Ammonia Salts.

At wholesale in New York, nitrogen in this form was quoted at about 14.9 cents per pound in December, 1885. It rose to 15.2 cents in February, 15.8 cents in March, and 16.4 cents in April. In May it declined to 15.8 cents and fell steadily to 14.4 cents in September. At present it is quoted at 14.7 cents per pound. The average wholesale cost through the year has been not far from 15 cents per pound. It has retailed in Connecticut for from 16.8 to 19½ cents per pound.

Nitrogen of Nitrate of Soda.

Nitrogen in this form was sold *at wholesale* in New York at 16 cents per pound in December of last year. It declined to 15.3 cents in February, rose in March to 16, and in May to 16.4 cents. It then declined rapidly to 13.7 cents in September and 12.7 cents at the time of this writing, a lower figure than it has ever reached before within our observation. It has retailed in the State at 17.7 cents to 19.7 cents per pound.

PHOSPHATIC MATERIALS.

Refuse Bone Black which sold at wholesale for $17.50 in December of last year, rose to $18.50 in February and has remained there ever since.

Ground Bone has been quoted at $29.50 during the whole of the past year.

There has been no change during the year in the quotations, either of *Charleston rock*, *f. o. b. New York*, or of *Sulphuric acid* 60°.

POTASH.

In Muriate of Potash.

Potash at wholesale in this form was quoted in New York in December of last year at 3.38 cents per pound. It rose in February to 3.48 cents and to 3.63 cents in March. It declined to 3.41 cents in May, 3.31 in July and is now quoted at 3.41. It has retailed during the year in this State for 3.9 cents to 5.4 cents per pound.

In Kainit.

Potash in Kainit at wholesale has cost during the year f 2.87 cents to 3.23 cents.

To recapitulate:

The fertilizer market, so far as we have been able to learn, been subject to the usual temporary fluctuations, but there been no considerable and permanent change in the market p of any of the standard raw materials from which mixed go are made. The market quotations given above are taken f the "Oil, Paint and Drug Reporter," published in New Y The weekly quotations for each month are averaged, and average is taken as the quotation for the month.

The following explanations will be helpful in the examina of the market quotations, and will also serve to show the basi which they have been interpreted in this review:

Phosphate rock, *kainit*, *bone*, *fish scrap*, *tankage*, and s other articles are quoted and sold by the ton. The seller usu has an analysis of his stock, and purchasers often control thi an analysis at the time of purchase.

Sulphate of ammonia, *nitrate of soda and muriate of po* are quoted and sold by the pound, and generally their whole and retail rates do not differ very widely.

Blood, *azotin and ammonite* are quoted at so much "per of ammonia." To reduce ammonia to nitrogen, multiply the cent. of ammonia by the decimal .824 (or multiply the percent of ammonia by 14 and divide that product by 17). A "uni ammonia" is one per cent., or 20 pounds per ton. To illustr if a lot of dried blood has 7.0 per cent. of nitrogen, equiva to 8.5 per cent. of ammonia, it is said to contain 8½ unit ammonia, and if it is quoted at $2.25 per unit, a ton of it will 8½ × 2.25 = 19.13.

The term "ammonia" is *properly* used only in those cases w the nitrogen actually exists in the form of ammonia, but it usage of the trade to reckon all nitrogen, in whatever for occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound f the cost per unit of ammonia in the market reports, the follow table is given.

Ammonia at	$4.00	per unit is	equivalent to	nitrogen at	24.3	cts.	per lb.
"	3.90	"	"	"	23.7	"	"
"	3.80	"	"	"	23.0	"	"
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.2	"	"
"	2.90	"	"	"	17.6	"	"
"	2.80	"	"	"	17.0	"	"
"	2.70	"	"	"	16.4	"	"
"	2.60	"	"	"	15.8	"	"
"	2.50	"	"	"	15.2	"	"
"	2.40	"	"	"	14.6	"	"
"	2.30	"	"	"	14.0	"	"
"	2.20	"	"	"	13.4	"	"
"	2.10	"	"	"	12.8	"	"
"	2.00	"	"	"	12.2	"	"

Commercial sulphate of ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	5	cents per lb.	Nitrogen	costs	24.4	cents per lb.
"	4⅞	"	"	"	23.7	"
"	4¾	"	"	"	23.1	"
"	4⅝	"	"	"	22.5	"
"	4½	"	"	"	21.9	"
"	4⅜	"	"	"	21.3	"
"	4¼	"	"	"	20.7	"
"	4⅛	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	3⅞	"	"	"	18.9	"
"	3¾	"	"	"	18.3	"
"	3⅝	"	"	"	17.6	"
"	3½	"	"	"	17.0	"
"	3⅜	"	"	"	16.4	"
"	3¼	"	"	"	15.8	"
"	3⅛	"	"	"	15.2	"
"	3	"	"	"	14.6	"

Commercial nitrate of soda averages 95 per cent. of the salt or 15.6 per cent. of nitrogen.

If quoted at	3⅝	cents per lb.	Nitrogen costs	23.2	cents per lb.
"	3½	"	" "	22.3	"
"	3⅜	"	" "	21.5	"
"	3¼	"	" "	20.8	"
"	3⅛	"	" "	19.9	"
"	3	"	" "	19.2	"
"	2⅞	"	" "	18.3	"
"	2¾	"	" "	17.6	"
"	2⅝	"	" "	16.9	"
"	2½	"	" "	16.0	"
"	2⅜	"	" "	15.2	"
"	2¼	"	" "	14.4	"
"	2⅛	"	" "	13.6	"
"	2	"	" "	12.8	"

Commercial muriate of potash usually has 80 per cent. of pure salt, or 50½ per cent. of actual potash.

If quoted at	2.00	cts. per lb.	Actual potash costs	3.96	cts. per lb.
"	1.95	"	" "	3.86	"
"	1.90	"	" "	3.76	"
"	1.85	"	" "	3.66	"
"	1.80	"	" "	3.56	"
"	1.75	"	" "	3.46	"
"	1.70	"	" "	3.36	"
"	1.65	"	" "	3.26	"
"	1.60	"	" "	3.16	"
"	1.55	"	" "	3.06	"
"	1.50	"	" "	2.96	"

The following table shows the fluctuations in the whol prices of a number of fertilizing materials in the New market, since May, 1883. The price given for each month i average of the four weekly quotations in that month. Sul of ammonia is assumed to contain 20.5 per cent. and nitra soda 15.6 per cent. nitrogen, and muriate of potash 50½ per of actual potash or 80 per cent. of the pure salt.

		COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH AT WHOLESALE IN
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1883.	May	18.2	18.9	16.3	20.1	3.34
	June	17.8	18.9	16.3	20.0	3.36
	July	17.2	18.9	15.6	19.0	3.23
	August	16.0	18.9	15.3	18.6	3.18
	September	15.3	17.0	14.8	17.6	3.21
	October	15.0	15.2	14.8	17.3	3.12
	November	14.5	15.2	15.2	16.4	3.20
	December	14.4	17.0	15.2	16.4	3.22
1884.	January	12.9	13.2	14.8	16.4	3.28
	February	13.2	13.7	14.3	15.0	3.23
	March	13.6	13.7	14.2	14.6	3.34
	April	13.6	13.6	14.0	14.6	3.38
	May	14.0	13.9	14.4	15.3	3.44
	June	13.9	13.5	13.8	14.6	3.36
	July	13.2	13.5	14.2	14.9	3.37
	August	13.6	13.3	14.3	14.7	3.36
	September	12.8	13.3	14.4	14.4	3.28
	October	12.9	13.2	14.3	14.8	3.38
	November	12.4	12.6	14.4	15.2	3.26
	December	12.1	12.8	14.4	15.2	3.32
1885.	January	12.3	13.0	14.1	15.2	3.32
	February	12.6	13.4	14.4	15.2	3.36
	March	13.4	13.7	13.2	15.2	3.58
	April	13.6	13.7	13.2	15.2	3.51
	May	14.3	13.7	14.1	15.2	3.54
	June	13.9	13.7	14.0	15.2	3.36
	July	13.6	13.6	14.0	15.0	3.31
	August	13.8	13.6	15.0	14.9	3.34
	September	13.4	13.5	15.6	14.8	3.36
	October	13.4	13.5	16.0	14.8	3.36
	November	13.8	13.5	15.6	14.8	3.38
	December	14.1	13.9	16.0	14.9	3.39
1886.	January	14.0	14.2	15.6	15.1	3.38
	February	14.2	14.3	15.2	15.2	3.46
	March	14.9	14.7	16.0	15.8	3.64
	April	14.9	15.7	16.1	16.4	3.56
	May	14.6	15.4	16.4	15.8	3.41
	June	13.9	14.7	15.6	14.6	3.32
	July	14.2	14.4	14.9	14.6	3.31
	August	14.1	14.4	14.0	14.5	3.31
	September	14.1	14.4	13.7	14.4	3.40
	October	14.4	14.4	13.2	14.6	3.41
	November	14.0	14.4	12.7	14.7	3.41

ANSWERS TO CORRESPONDENTS.

Action of Plaster (Gypsum) on Manure.

A correspondent writes: “ Various claims made by dealer terested in the sale of gypsum or land plaster lead me to ask following questions:

1. Does plaster have a strong affinity to nitrogen?

2. Is sulphate of ammonia less volatile and therefore less li to waste than carbonate of ammonia?

3. Does plaster sprinkled in stables and on manure heaps, in privy vaults check the waste of ammonia, and thereby materially to the value of the manure heap?

4. Is there ordinarily much loss of ammonia in stables w no absorbent is used?

5. Does dry loam sprinkled on manure answer as well to re the ammonia and hold it till wanted by the plants?

6. Does the carbonate of lime found in the plaster from cer sections tend to counteract the good effects produced by application of sulphate of lime, either by rendering the plant f more volatile, or by neutralizing the good effects of the sulph

7. Does plaster mixed with manure hasten or check dec position?”

To this correspondent was replied essentially as follows:

1. Plaster has no strong affinity for *nitrogen*. When dissol in water it will absorb and retain carbonate of ammonia. Pla is sulphate of lime, and in presence of water is decompose carbonate of ammonia. Sulphate of ammonia and carbonat lime are formed by this double decomposition.

2. Carbonate of ammonia is volatile at ordinary temperatu the strong ammoniacal odor of stables and urinals is due t Sulphate of ammonia is not volatile, hence:

3. Plaster sprinkled on moist manure heaps and on st floors wet with urine does prevent loss of ammonia.

4. How great the loss of ammonia may be in stables, etc., not easy to say. An amount of ammonia can be smelled whic very small, and might not pay for the saving, but no doubt loss under some circumstances, particularly in summer weat is considerable. Another advantage of using plaster in stabl this, that the air which the animals breathe is kept sweeter more wholesome.

5. Loam is a very excellent deodorizer and absorbent of ammonia. It would have to be used in much larger quantity than gypsum, and would therefore increase very considerably the weight of the manure to be handled.

6. Carbonate of lime in plaster simply dilutes it. The fixation of ammonia is caused solely by the sulphate of lime; the less sulphate of lime present the less the efficiency of the plaster as an absorbent.

7. The amount of plaster which would be added to manure to prevent loss of carbonate of ammonia would probably not retard the decomposition of the manure.*

TO INCREASE STIFFNESS OF STRAW.

To the question: What may be added to "fish and potash" to make it a more complete fertilizer for rye which has suffered from want of stiffness in the straw, the answer is, to try lime in some form. Oyster shell screenings or cheap lime of any kind—20 or 30 bushels to the acre may be used. Old wall plaster or common mortar crushed, or leached ashes which are mostly carbonate of lime would do as well. An application of lime at this time of year (November) broadcasted on the growing rye would be safe. Many English farmers, years ago, had the habit of using two or three bushels of salt to the acre on grain crops, as they said, to stiffen and brighten the straw. It is however probable that the fish and potash contains enough salt to make that application unnecessary. This recommendation is made in the hope but not in the full assurance that it will be of service.

POTATO SCAB.

In reference to an inquiry as to the cause and cure of potato scab the results to which German investigators have arrived are

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* According to Dr. C. H. Meyer-Altenburg, the use of 2 or 2½ pounds of plaster to 100 pounds of stable manure perceptibly checks decomposition when access of air to the manure is prevented by building it up into cubical heaps, which are thoroughly trodden down and frequently watered with the urine and drainings collected in a cistern close at hand. Under such conditions it is stated that a manure heap 6 feet high settled but 2 inches during a summer, while a similar heap without plaster settled 7 inches. The heap of plastered manure is said to have settled but 6 inches during an entire year, and at the end of that time to have retained its fresh appearance and greenish color. Under the ordinary treatment which manure receives such a preservative effect does not appear to have been noticed.

of interest. In the Station Report for 1877, p. 67, will be
a short article on this subject and what follows is in part a r
tion of statements there printed.

The skin of the healthy potato tuber consists of a layer of
cells of uniform thickness and when the skin is injured or a
tion of it cut away, the wound heals by the formation of a
layer of cork which reproduces itself in a manner very simi
what takes place when the skin of an animal forms again o
wound. When the potato tuber grows in water or when th
is kept unduly wet, the cork layer increases in thickness at va
points producing a multitude of little warts upon the su
Where these warts occur the cuticle is less resistant than o
wise and decay of the tissue underneath is likely to take
If the excess of water about the tuber continues for a consi
ble time, decay sets in and the starch and tissues of the
become discolored. When under favorable conditions dec
arrested the cork layer forms between the decayed and
healthy parts of the potato and the potato is "scabby."

This affection of the potato is accordingly the result of e
of moisture, either because the soil is wet from situation o
cause of its texture or on account of the occurrence of a
tracted period of wet weather. Stable manure and other ferti
influence it as they affect the state of moisture in the soil. S
manure may also aggravate the disease by filling the soil wit
spores or seeds of moulds or fungi which taking root in
injured cork layer may favor decomposition of the tuber and
tract the healing process." Saline fertilizers, like potash
may antagonize scab by hindering the growth of fungi.

ON THE AGRICULTURAL VALUE OF HORN D AND OF HORN AND HOOF.

In the last Report an account was given of some experin
on methods of testing the agricultural value of nitrogen in n
fertilizers founded on their solubility in pepsin solution and o
rapidity of their decay in the presence of ferments which in
putrefaction. All the raw materials which are likely to be i
porated with mixed fertilizers were tested by these two met

The results were briefly these:

1. Seventy-five per cent. or more of the nitrogen of

blood, cotton seed, castor pomace and maize-refuse, under the conditions of the experiment, was soluble in pepsin solution.

2. Fifty-two per cent. or more of the nitrogen of fish, tankage, horse meat, etc., and of bone was soluble.

3. In no case was more than thirty-six per cent. of the nitrogen of leather (roasted, steamed or extracted with benzine), soluble, and the nitrogen of horn shavings, horn dust, ground horn and hoof, cave guano, felt waste and wool waste was considerably less soluble than that of leather.

It was in the next place desirable to learn whether the solubility of nitrogen in pepsin solution, under the conditions here employed, bore any general relation to the actual availability of the nitrogen as plant food. During the last season some vegetation experiments have been made at this Station on the availability of the nitrogen in "horn dust" and in "horn and hoof" as compared with that of nitrogen in the form of dried blood.

A requisite condition for the success of any vegetation experiments, whether in the field or plant house, as has been pointed out by Hellriegel, Wagner and others, is that the factor of production which is under experiment should be in relative minimum as regards every other factor. For example, in the case in hand, the fertilizing effect of nitrogen in various forms is to be studied, being measured by the amount of crop produced. Nitrogen then must at all times be in a minimum, as regards the other factors of crop production. But suppose that at some time during the experiment the crop suffers from drought. Water is then at a relative minimum. During this time it is water and not nitrogen that limits the growth of the crop. The crop which had grown best previously when nitrogen controlled production, now suffers most because its more abundant foliage exhausts more rapidly and completely the water of the soil, and it may be that the plants will be "burned" by the richer nitrogenous manure while the crop supplied with the less valuable nitrogenous matter will fare better. In any event the result will be of no value. Or again suppose the land experimented upon cannot furnish the amount of potash necessary for a maximum crop of the kind under experiment. Then crop production is conditioned on the potash present and may be very little if at all affected by the application of nitrogen. On such land dried blood might produce very little more than leather. In all cases the experimenter must prove that all other factors of crop production are in relative maximum to the one factor under investigation.

The experiments to be described were made in pots of which has been proposed and used by Wagner. Each con a cylinder of galvanized iron twenty inches high and ten inside diameter. The cylinder has handles set on the side ways below the rim and has a row of perforations around eighth of an inch from the bottom. This cylinder is solder the middle of a galvanized iron pan three inches deep an teen and a half inches in diameter. Through the bottom pan, an inch from the edge, pass two tubes, one being flus the bottom of the pan inside, the other rising two inches. project 1½ inches below the bottom. The first is used o washing out the pot and at other times is corked; the the overflow tube. The pot is finished by soldering on between the upper edge of the pan and the outside cylinder. Through this collar passes a tube by which wa be poured into the pan or reservoir. When water is pour will rise in the reservoir and through the perforations i cylinder to the height of two inches and if more is pour will then run off through the overflow. When the pots ar earth there will be water standing 18 inches below the and if they are daily cared for there can be no lack of wat heavy rain will saturate the soil and the excess will through the overflow into a bottle placed below to rec The pots were painted white on the outside so as to abs little of the sun's heat as possible and within were coate the best quality of asphalt to prevent rusting. During the ment they stood on a low table that ran nearly due east an and which was unshaded during the entire day. On a below the table bottles numbered to correspond with th were so placed as to receive all the overflow.

Earth for the experiments was taken from under sod whi not been fertilized for years and on which applications o genous manure always had a marked effect. It is a ligh soil overlying "red rock" (coarse conglomerate sandston has little natural fertility. This earth was sifted to remove and roots and was very thoroughly mixed.

The filling of the pots required considerable care to insu the earth was uniformly packed in all the pots. For this following method was adopted. The bottom of each of pots in the series was covered with rather fine gravel (2½ t diameter) to the depth of one inch and then into each of th was weighed 10 pounds of earth or one-sixth of the total quantity required. This was evenly spread and gently pressed down, with a block of wood fitted with a handle for the purpose, until the layer of earth was just three inches thick as was determined by measuring the distance from its surface to the rim of the pot. A second layer was put in each pot in the same way and then a third. All the pots were now half full. For the first pot in the series the total quantity of earth needed to finish filling it was next weighed out and to this was added the fertilizer to be used. The two were very carefully and thoroughly mixed together. Then one-third of this mixture was weighed into the pot, pressed down as already described and afterwards the other two portions in the same way. In like manner all the other pots were prepared. As soon as the pots were ready the reservoirs were filled with water and were thereafter filled every morning during the entire period of growth. After a rain the water that had percolated through the soil was first used.

The water used in these experiments was city water containing between 4 and 5 grains of solid matters to the gallon and two to five parts of "albuminoid ammonia" in one hundred million of water. Previous to use it was passed through a filter of sand and wood charcoal.

The crop grown was Welcome Oats from seed bought of a seedsman in New Haven. The seed was counted out in lots of twenty kernels, and each lot was weighed and only those were used which were almost identical in weight. The kernels weighed together about 0.5 gram and contained .013 grams of nitrogen. To plant the seed in a perfectly uniform way in the different pots a disc of wood was prepared having twenty equidistant holes. This was laid on the surface of the soil in the pot, through the holes the seed was put on the soil, the disc was removed and a weighed amount of soil was spread over the seed covering it to a depth of three-quarters of an inch. This last stratum of earth was gently packed.

Each pot received 2.28 grams of muriate of potash, containing 52 per cent. actual potash, and the same quantity of bone black superphosphate with 17 per cent. available phosphoric acid. These quantities are equivalent to an application of about 400 pounds of muriate and 400 pounds of superphosphate per acre.

The nitrogenous matters used in the experiment were as follows: Dried blood containing 13.40 per cent. of nitrogen, ground horn and hoof containing 13.54 per cent., and horn shavings containing 15.37 per cent. All these materials were ground t powder that would readily pass a one-fiftieth inch sieve. are the identical samples which were used last year in the tion experiments with pepsin above referred to. The amo these nitrogenous matters used, and the equivalent nitrog be seen by reference to the next table. All the weights gi in grams.

The applications of nitrogen are equivalent to 20, 40 pounds of nitrogen per acre, or about what would be supp 240, 480 and 720 pounds of dry ground fish.

The object in using these different quantities of nitrogen i of a uniform quantity in all, is this: If nitrogen had been at the rate of 60 pounds per acre there would be no proc this was not an excessive amount. In that case nitrogen not have been in a relative minimum. But on the prese the increased yield of 40 pounds over 20 shows that the quantity was not excessive; the increase made by 60 over 40 pounds again shows that 40 pounds was not excess

The pots were filled on the 29th and 30th of April last, a oats were planted on May 3rd. A week after planting the thinned so that each pot had 18 plants only. This was d keep the series alike, as in one pot only 18 seeds produced The oats grew thriftily up to the time of flowering, wher appeared on one or two plants in all the pots but Nos. 77, and 89. Most of the crops did not seem to be seriously da No. 84 was considerably injured, four of the stalks being infected with smut. The oats were harvested on the 21st before all were perfectly ripe. This was necessary, as in pots the seeds had began to fall. The details with regard fertilizers applied, and the crops harvested, are given in t table on the following page.

Certain points require special mention before proceedi discussion of the general results. The first six pots of the received no addition of nitrogen, and show the capacity soil itself for production under the conditions of the expe The first two numbers, 73 and 74, should be left out of the a as they stood at the end of the row, and for that reaso differently exposed than the others to light and heat. Th end of the row was protected by another series of pots total yield from .342 grams of blood-nitrogen would hav ably been much larger but that one of the pots, No. 84, received this dose of nitrogen was much more seriously at

No.	Weight of Nitrogenous Fertilizer added. (The seed in each pot contained 0.018 grams of Nitrogen)	Weight of Nitrogen added in the fertilizer.	Dry weight of crop.	Total weight of nitrogen in the crop.
73	None.	None.	(21.8)	(.1762)
74	"	"	(19.9)	(.1730)
75	"	"	23.4	.2042
76	"	"	25.1	.2112
77	"	"	22.4	.2055
78	"	"	22.9	.2050
79	.8508 of dried blood.	.114	29.6	.2378
80	.8508 "	.114	29.7	.2410
81	1.7015 "	.228	32.7	.2816
82	1.7015 "	.228	33.3	.3173
83	2.5524 "	.342	41.6	.3844
84	2.5524 "	.342	35.4*	.3139
85	.8419 ground horn and hoof.	.114	24.1	.2056
86	.8419 " "	.114	26.0	.2346
87	1.6838 " "	.228	26.5	.2411
88	1.6838 " "	.228	28.6	.2528
89	2.5257 " "	.342	33.1	.2886
90	2.5257 " "	.342	32.7	.2808
91	.7417 horn shavings.	.114	22.5	.2073
92	.7417 " "	.114	19.4	.2457
93	1.4834 " "	.228	26.1	.2280
94	1.4834 " "	.228	28.5	.2534
95	2.2251 " "	.342	32.3	.3140
96	2.2251 " "	.342	32.8	.2870

* Most seriously attacked by smut.

by smut than any other. No reason can be assigned for the fact that the yield in pots Nos. 91 and 92 was less than in those that had received no nitrogen.

The average yield of the four pots which received no addition of nitrogen, Nos. 75, 76, 77 and 78, was 23.5 grams.

The general results of the experiment are given in the following tables. The total weight of crop given in each case is the sum of the weights of the crops in the two pots which had like quantities of the same nitrogenous fertilizer. The weights are expressed in grams. (See table on page 86.)

A comparison of these results brings out the following facts: With the minimum dose of nitrogen (.228 gram in the two pots) blood-nitrogen caused an increase of crop over that of the unfertilized pots about four times as large as that caused by horn-nitrogen. When this minimum dose of nitrogen was doubled, the increase caused by blood-nitrogen was about two and a half times as much as that caused by a like quantity of horn-nitrogen. With the treble dose of nitrogen the increase from blood-nitrogen was only about one and three-quarters times as much as from

YIELD OF DRY MATTER IN CROP.

[Yield without added nitrogen was 47 grams.]

Nitrogen in each two pots.*	Total Yield.			Total gain over unmanured.			Per cent. gai unmanur	
	Blood.	Horn and Hoof.	Horn Shavings.	Blood.	Horn and Hoof.	Horn Shavings.	Blood.	Horn and Hoof.
.228	59.3	50.1	41.9	12.3	3.1	–5.1	26.2	6.6
.456	66 0	54.9	54.6	19.0	7.9	7.6	40.4	17.0
.684	77.0	65.8	64.1	30.0	18.8	17.1	63.8	40.0

YIELD OF NITROGEN IN CROP.

[Yield of nitrogen in pots without nitrogenous fertilizer added was .4

Nitrogen in each two pots.*	Total Nitrogen.			Total Nitrogen gain over unmanured.			Per cent. gain of over unman	
	Blood.	Horn and Hoof.	Horn Shavings.	Blood.	Horn and Hoof.	Horn Shavings.	Blood.	Horn and Hoof.
.228	.4788	.4402	.4530	.0658	.0272	.0400	15.9	6.5
.456	.5989	.4939	.4814	.1859	.0809	.0684	45.0	19.6
.684	.6983	.5694	.6010	.2853	.1564	.1880	69.1	37.8

horn-nitrogen. Or otherwise expressed, in this experim application of nitrogen at the rate of twenty pounds per the form of blood produced four times as much *increase over unmanured land* as the same amount of horn-ni When nitrogen at the rate of forty pounds per acre was in the form of blood, the increase was two and a half ti much as that got from the same amount of nitrogen in the horn, and when sixty pounds of nitrogen were applied crease of crop caused by blood-nitrogen was only one and quarters as much as that caused by horn-nitrogen. If w sider the increase of *nitrogen* of the crop, 20 pounds per blood-nitrogen gave nearly twice as much increase as th amount of horn-nitrogen, 40 pounds of blood-nitrogen gave two and a half times as much increase as the same quantity of horn-nitrogen, and 60 pounds of blood-nitrogen gave one and two-thirds as much increase as the same quantity of horn-nitrogen.

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* This does not include .026 grams of nitrogen contained in the seed wh added to both manured and unmanured pots.

The crop-producing power of the nitrogen of blood and of horn becomes then more nearly alike as the amount of nitrogen applied is increased. The reason is obvious. Since a portion of the nitrogen of horn is available, it is possible to add enough of it to supply all that a maximum crop requires. With each successive increase in the amount applied the production of a maximum crop is more nearly attained, and hence the difference in availability between it and blood will grow smaller. Moreover when the amount of decomposing organic matter in the soil is increased to a certain limit—and the limit is reached sooner with an easily decomposable material like blood than with an inert one like horn,—the crop production is checked by the too rapid decay in the soil so that if the nitrogen additions were increased in the same ratio as in these experiments it might easily happen that the horn would give a larger yield than the blood for the reason that the excessive amount of blood added would "burn" the crop.

It is noticed that with the smallest application of horn shavings the yield of dry matter, viz: 41.9 grams, was less than that, obtained (47 grams), from the unmanured pots. Nevertheless the nitrogen (.453) in the smallest crop was not only greater than that, (.413), of the crop to which no nitrogen was added, but also noticeably exceeded the amount of nitrogen (.4402), in the larger crop obtained from a corresponding quantity of horn and hoof. These anomalies no doubt depend on irregularities of growth partly due to the seed and to "accidental" (that is unknown), circumstances or conditions. It should be remembered that the plants when harvested had not equally ripened. The ripening process, as is well known, is in part a growth of the upper organs of the plant at the expense of the lower. It is perhaps probable that the "crops," that is the cropped parts, showed a wider variation than the entire plants would have shown in consequence of this unequal distribution of dry matter in root and "crop" due to differences of ripeness at the time of harvesting. The ratio of increase of crop produced by the different doses of nitrogen, over the amount of crop in the pots to which no nitrogen was added, calling the increase produced by blood-nitrogen in each case 100, is as follows:

RELATIVE INCREASE OF DRY MATTER IN THE CROP.

Nitrogen added.	Blood.		Horn and Hoof.		Horn Shavings.
.228	100	:	25.2	:	----
.456	100	:	41.6	:	40.0
.684	100	:	62.6	:	57.0
Average,	100	:	46.5	:	48.5

RELATIVE INCREASE OF NITROGEN IN THE CROP.

.228	100	:	41.3	:	60.8
.456	100	:	43.5	:	36.7
.684	100	:	54.8	:	65.9
Average,	100	:	46.5	:	54.4

The results are too irregular to justify any fine conclusion
the average increase both of dry matter and of nitrogen is
to be twice as much in the case of blood-nitrogen as in t
horn-nitrogen. This result is to be understood as applyi
these materials in a high state of pulverization whereas h
ordinarily used, is very much coarser and therefore less
than blood.

With these results we may here compare the outcome
laboratory experiments made last year upon these same mat
in the same state of pulverization. The relative solubility
three materials—

	Blood.		Horn and Hoof.		Horn Shav
In pepsin solution was......	100	:	28.9	:	23.0
After putrefaction was......	100	:	40.9	:	27.8

Our vegetation experiments give on the whole a higher f
ing value than would be inferred from their solubility und
peptic and putrefactive ferments. It is to be considered ho
that in the vegetation-experiments the materials were under
solution or alteration for 11 weeks while in the laboratory e
ments the action of the ferment lasted from 24 hours to 2

In these experiments both "horn and hoof" and "horn
ings" proved to be of very inferior value as fertilizers in
parison with dried blood. On soil of an entirely different c
ter the results might have been different and yet it is pr
that on any soil where the conditions were all suitable for t
factor of nitrogen to have a controlling influence on crop-p
tion, the result would not have been *essentially* different fron
Horn shavings are used and prized as a fertilizer. The
cheap, can therefore be used in large quantity, they ligh

heavy soil as long manure would do and they furnish nitrogen durably to the crop. The station valuations for blood-nitrogen and horn-nitrogen are respectively 17 and 9 cents per pound. The ratio of these prices is as 100 : 52.9. The average increase of crop by both horn-fertilizers in our pot-experiments bears to that given by blood the ratio of 100 : 47.5. The average increase of nitrogen in the crops, from use of the same, is 100 : 50.5. The pot-experiments therefore on the whole confirm the justness of the Station Valuations in respect to the relative worth of these two sources of nitrogen.

ANALYSES OF FEEDING STUFFS.

EXPLANATIONS CONCERNING THE ANALYSIS, VALUATION AND ECONOMICAL USE OF FEEDING STUFFS.*

In order to feed animals most rationally and economically it is necessary to know:

1st. The composition of the feeding stuffs which make up their ration.

2nd. What percentage part of the different ingredients of these feeding stuffs can be digested by the animals.

3rd. How many pounds of the digestible materials must be daily supplied to each animal in order to get the maximum production of milk, of flesh, of wool, or of work; or in order to keep the animal, if at rest, simply in good condition.

I.—THE COMPOSITION OF FEEDING STUFFS.

This is determined by chemical analysis. On subsequent pages is given in tabular form the average composition of the feeding stuffs commonly used in this country, compiled exclusively from American analyses. In the first column of these tables is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

As it is very desirable to know within what limits the composition of each fodder is likely to vary, the maximum and minimum amounts of each ingredient have also been inserted in the table.

The following explanations may be helpful to the ready understanding of these tables.

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* Reprinted with minor changes from the Report for 1885.

EXPLANATIONS OF ANALYSES OF FEEDING STUFFS.

The analysis gives the percentage amounts of Total Dry Matter, Albuminoids or Protein, Crude Fat, Nitrogen-free Extract, Fiber and Ash.

Total Dry Matter is what remains of a feeding stuff when all the water it contains is removed. However dry a feeding stuff may appear to be, it always contains a considerable and variable proportion of water which is invisible and imperceptible to the senses, but which can be driven out by heat and which the perfectly dried fodder recovers more or less fully when exposed to the air. This amount of water thus present in feeding stuffs is constantly changing with the temperature and dryness of the air to which they are exposed, and accordingly no proper comparison of different foods is possible unless the proportions of water they contain is known and comparison is made on perfectly dry or water-free substance.

In the Station laboratory, water is expelled and the amount of Dry Matter determined by heating a weighed quantity of the feeding stuff at 212° Fahr. in a stream of hydrogen gas until no further loss of weight occurs.

Albuminoids (*or Protein*) is a general term which includes all those nitrogenous materials of a feeding stuff which bear a general resemblance in composition and properties to egg albumin (white of egg), flesh fibrin (lean meat), and milk casein (curd). The quantity of albuminoids is usually estimated by multiplying the per cent. of nitrogen present by 6¼. This method is based on the fact that the albuminoids all contain not far from sixteen per cent. of nitrogen, which figure multiplied by 6¼ gives 100 per cent. or the total amount of albuminoid corresponding to the nitrogen. Some of the albuminoids contain indeed less and some more than this per cent. of nitrogen, but, for practical purposes, the assumption of sixteen per cent. is sufficiently exact in most cases.

It is believed that the vegetable albuminoids do not greatly differ in nutritive effect or at least, since each feeding stuff commonly contains a mixture of several distinct albuminoids, the *digestible portions* of these various mixtures do not widely differ in nutritive value.

Besides albuminoids, certain feeding stuffs, chiefly root crops, and immature parts of plants, such as hay from young grass, contain a portion of their nitrogen in an entirely different form; as

COMPOSITION OF AMERICAN FEEDING STUFFS.

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
GREEN FODDER.																	
Maize Fodder	48	7.1	30.9	19 02	.6	3.0	1.63	.1	.9	.41	3.2	19.7	10.62	1.9	11.4	5.23	1.13
Maize Fodder, ensilaged	53	12.3	29.2	19.54	.9	2.8	1.51	.2	1.8	70	5.1	16.5	10.21	4.0	10.0	5.77	1.35
Sorghum	5	13.6	28.4	23.92	1.0	1.4	1.16	.2	.4	33	5.3	27.0	14.87	5.5	8.5	6.65	.91
Sorghum, ensilaged	5	22.0	28.1	24.17	.6	.9	.75	.1	.4	.28	13.8	19.0	15 82	5.9	6.8	6.28	1.04
Rye fodder	6	21.9	25.3	24.72	2.3	3 0	2.61	.2	.7	.56	4.9	12.4	6.94	4.9	14.9	12.73	1.88
Rye fodder, ensilaged	1	....	....	19.25	....	....	2.42	....	...	.27	....	....	9.18	....	....	5.76	1.62
Clover	1	....	....	26.67	....	....	4.09	....	....	.69	....	....	11.61	....	....	8.12	2.16
Clover, ensilaged	3	21.5	27.4	23.73	3.0	3.8	3.34	.9	1.1	1.02	8.1	11.4	10.21	5.1	8.6	6.66	2.50
Cow pea vines, green and succulent, with pods	3	14.0	27.2	19.69	1.9	3.3	2.70	.2	.6	.47	5.3	8.5	7.41	2.9	15.3	7.22	1.89
Cow pea vine, ensilaged	1	....	....	18.36	....	....	2.40	....	....	.80	....	....	7.60	....	....	5.57	1.99
Soy bean, entire crop	3	29.6	30.7	30 13	2.2	3.9	3.34	.9	1.6	1.16	14.2	16 0	14.88	7.9	8.9	8.36	2.39
Beet leaves	1	....	....	11.16	....	....	2.74	....	....	.60	....	....	2.49	....	....	2.50	2.83
Carrot leaves	1	....	....	16.70	....	....	4 26	....	....	.86	....	....	5.99	....	....	2.25	3.34
Cabbage, ensilaged	1	....	....	12.39	....	....	1.19	....	....	.93	....	....	4.52	....	....	1.59	4.16

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
HAY AND DRY COARSE FODDER.																	
Clover hay	25	78.2	92.0	*87.44*	8.9	20.8	*12.61*	1.5	4.3	*2.48*	35.0	45.5	*39.62*	15.6	33.7	*26.63*	6.10
Hay containing much clover	8	85.5	88.6	*86.06*	6.4	14.4	*10.41*	1.5	3.3	*2.59*	35.8	45.2	*41.59*	19.7	29.5	*25.97*	5.50
Timothy hay, [*Phleum pratense*]	40	84.5	92.9	*88.93*	4.2	9.6	*6.02*	1.0	3.4	*2.16*	39.2	58.5	*45.82*	22.7	38.5	*30.89*	4.06
Red top [*Agrostis vulgaris*]	1	....	....	*90.16*	....	....	*7.25*	....	....	*1.95*	....	....	*46.52*	....	...	*27.45*	6.99
Timothy and Red top	10	85.7	91.8	*87.64*	4.8	9.0	*6.52*	1.5	2.7	*2.00*	38.5	48.9	*44.15*	24.7	38.4	*30.17*	4.80
Orchard grass hay, [*Dactylis glomerata*]	1	....	....	*88.20*	....	....	*8.17*	....	....	*2.26*	....	....	*33.54*	....	....	*38.33*	5.90
Hungarian grass hay	6	91.3	95.1	*93.55*	5.6	8.8	*6.79*	2.1	3.5	*2.55*	46.9	50.9	*49.69*	26.4	31.3	*29.09*	5.43
Barley hay, (Seed in milk)	1	....	....	*89.75*	....	....	*9.21*	....	....	*2.47*	....	....	*47.49*	....	....	*26.14*	4.44
Oat hay, (Seed in milk)	2	90.4	91.3	*90.85*	7.8	9.9	*8.90*	2.4	3.1	*2.74*	41.6	48.0	*44.79*	25.1	31.0	*28.07*	6.48
High meadow hay	2	88.7	89.4	*89.02*	6.8	8.3	*7.57*	2.0	2.5	*2.25*	46.9	47.5	*47.19*	24.3	25.2	*25.78*	6.23
Hay from mixed meadow grasses	9	81.0	87.0	*84.52*	4.9	7.9	*6.24*	1.4	2.7	*2.05*	34.4	47.3	*40.43*	23.7	35.9	*31.09*	4.71
Low meadow hay	10	85.5	93.6	*89.50*	4.6	10.4	*7.70*	.7	3.6	*2.20*	39.8	55.2	*43.60*	21.4	40.0	*30.20*	5.80
Salt marsh hay	11	81.4	92.8	*89.53*	4.3	7.8	*5.90*	1.6	3.1	*2.32*	34.1	53.7	*42.42*	27.0	37.9	*31.47*	7.42
Maize stover	5	75.0	84.7	*80.44*	4.3	8.3	*5.89*	1.3	1.9	*1.57*	36.5	46.2	*41.56*	23.4	27.2	*25.61*	5.79
Maize fodder, field cured	6	60.6	77.1	*67.95*	3.4	5.0	*4.29*	.7	1.6	*1.24*	30.5	40.8	*35.96*	18.7	25.2	*22.14*	4.32
Buckwheat straw	2	89.5	89.6	*89.55*	3.3	4.4	*3.85*	1.4	1.7	*1.56*	32.1	34.5	*33.28*	44.9	46.8	*45.88*	5.05
Oat straw	4	87.5	93.5	*90.38*	2.3	5.1	*3.51*	1.0	3.2	*2.21*	26.4	44.3	*36.09*	35.2	56.0	*43.37*	5.20
Rye straw	2	87.5	90.2	*88.89*	2.2	6.9	*4.54*	1.0	2.7	*1.84*	35.7	41.0	*38.37*	34.2	43.3	*38.75*	1.84
Wheat straw	1	....	....	*93.50*	....	...	*4.98*	....	....	*1.49*	....	....	*41.99*	....	....	*38.08*	6.96
Cow-pea vines	6	86.0	90.7	*88.95*	13.6	19.8	*15.68*	1.1	4.1	*2.87*	34.9	46.4	*42.17*	17.2	23.7	*19.8*	8.41

Composition of American Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
Roots, Bulbs, Tubers and other Vegetables and Fruits.																	
Beets, red	2	10.5	12.3	*11.43*	1.5	1.7	*1.60*	.2	.2	*.18*	7.2	7.6	*7.40*	.6	1.7	*.12*	1.08
Beets, sugar	7	9.2	16.4	*13.03*	1.7	2.8	*2.01*	.1	.2	*.08*	5.7	12.0	*9.12*	.7	1.1	*.88*	.94
Mangolds	5	5.6	11.7	*8.24*	1.0	1.9	*1.53*	----	.5	*.15*	2.4	8.4	*4.67*	.8	1.0	*.86*	1.03
Ruta bagas	1	----	----	*12.92*	----	---	*1.15*	----	----	*.09*	----	----	*9.11*	----	----	*1.16*	1.41
Turnips	1	----	----	*11.11*	----	----	*1.34*	----		*.09*	----	----	*8.11*	---	----	*.86*	.71
Carrots	5	8.9	13.5	*12.04*	.8	2.0	*1.22*	.2	.7	*.46*	5.1	10.4	*7.86*	1.0	2.3	*1.45*	1.05
Onions	6	6.5	18.4	*12.45*	.8	2.3	*1.41*	.2	.4	*.26*	3.8	14.1	*9.53*	.6	.8	*.69*	.56
Potatoes	6	19.4	23.8	*21.53*	1.1	3.0	*2.12*	----	.2	*.10*	15.3	19.9	*17.88*	.3	.9	*.54*	.89
Sweet potatoes	3	26.6	34.0	*29.72*	.5	1.2	*.98*	.3	.3	*.32*	23.0	29.7	*26.13*	.6	2.5	*1.36*	.93
Cabbage	1	----	----	*6.41*	----	----	*2.01*	----	----	*.19*	----	----	*2.00*	----	----	*1.44*	.72
Squash	2	4.8	-5.4	*5.12*	.6	.6	*.66*	.2	.3	*.28*	2.9	3.5	*3.24*	.5	.5	*.54*	.40
Pumpkin	1	----	----	*7.73*	----	----	*1.11*	----	----	*.16*	----	----	*4.34*	----	----	*1.49*	.63
Apples	5	15.9	22.7	*18.22*	.2	1.2	*.69*	.3	.6	*.41*	12.6	20.0	*15.31*	.9	2.9	*1.49*	.32

Composition of American Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
GRAIN AND OTHER SEEDS.																	
Barley	9	87.4	92.7	*89.08*	8.6	15.7	*12.39*	1.5	3.1	*1.86*	66.7	73.9	*69.88*	1.2	4.1	*2.57*	2.38
Buckwheat	8	85.1	89.1	*87.40*	8.6	11.0	*10.00*	2.2	2.4	*2.25*	62.6	65.4	*64.50*	7.8	9.4	*8.70*	2.00
Oats [raised in Conn.]	7	86.5	90.7	*89.06*	8.0	10.1	*9.32*	4.7	5.8	*5.29*	59.0	63.2	*61.55*	8.9	12.9	*9.95*	2.95
Oats	25	86.5	91.1	*89.06*	8.0	14.4	*11.38*	3.4	5.8	*4.81*	50.8	66.9	*60.05*	1.5	19.4	*9.85*	2 97
Rye	6	86.8	91.3	*88.40*	9.5	12.1	*10.60*	1.4	2.1	*1.70*	70.7	73.9	*72.60*	1.4	2.1	*1.60*	1.90
Wheat, winter	242	83.8	92.9	*89.48*	8.3	16.6	*11.73*	1.8	3.9	*2.11*	68.1	76.6	*72.01*	.4	2.9	*1.77*	1.86
" Spring	13	86.6	91.9	*89.63*	8.1	15.4	*12.51*	1.8	2.5	*2.20*	66.1	78.6	*71.19*	1.3	2 3	*1.82*	1.91
" Unclassified	55	87.6	90.9	*89.31*	9.8	14.7	*11.96*	1.6	2.8	*2.10*	68.5	74.7	*71.50*	1.2	3.1	1.92	1.83
" Average of all Analyses	310	83.8	92.9	*89.46*	8.1	16.6	*11.80*	1.3	3.9	*2.11*	66.1	78.7	*71.89*	.4	3.1	*1.80*	1.86
Maize, dent	78	85.9	93.7	*89.90*	7.5	12.1	*10.34*	3.8	6.9	*5.13*	66.2	75.7	*70 59*	1.2	4.8	*2.29*	1.55
" Flint	70	80.4	93.4	*88.93*	7.0	13.7	*10.57*	3.4	7.1	*4.96*	65.0	74.6	*70.31*	.7	2.9	*1.65*	1.44
" Sweet	26	89.1	94.0	*91.18*	9.5	15.3	*11.62*	3.8	11.9	*8.14*	61.8	72.4	*66.70*	1.5	5.2	*2.80*	1.92
" "Western Corn"	3	79.3	83.6	*80.90*	7.8	8.6	*8.30*	3.6	3.9	*3.70*	64.9	68.2	*66.00*	1.7	1.8	*1.75*	1.20
" Average of all varieties	190	79.3	94.0	*89.48*	7.0	15.3	*10.58*	3.4	11.9	*5.46*	61.8	75.7	*69.81*	.7	5.2	*2.08*	1.55
Sorghum Seed	9	83.2	90.7	*87.48*	7.6	11.2	*8.88*	2.1	4.6	*3.65*	66.8	73.6	*71.27*	1.4	3.2	*1.88*	1.80
Cotton Seed, hulls and kernels	1	....	....	*92.28*	....	....	*15.72*	....	....	*18.56*	....	....	*29.09*	....	....	*25.73*	3.16
Cow pea	5	79.2	89.9	*85.21*	19.3	23.0	*20.77*	1.3	1.6	*1.43*	48.1	61.9	*55.75*	3.3	5.0	*4.06*	3.20
Doura, brown	3	87.3	92.4	*89.00*	9.0	11.5	*10.30*	....	....	*4.20*	....	....	*69.90*	....	....	*1.50*	1.60
Soy Bean	3	89.8	93.9	*91.41*	34.6	38.6	*36.22*	16.8	19.0	*17.92*	26.2	30.5	*28.66*	3.6	5.0	*4.24*	4.37

Composition of American Feeding Stuffs—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FLOUR AND MEAL.																	
Barley Meal	3	83.8	86.0	*84.90*	8.8	13.9	*11.80*	.7	2.2	*1.70*	....	....	*70.90*	....	....	*.10*	.50
Buckwheat Flour	3	85.0	87.2	*86.48*	4.2	8.0	*6.48*	.6	1.7	*1.33*	75.8	79.4	*77.34*	.2	.3	*.28*	1.05
Oat Meal	6	91.1	93.8	*92.15*	12.9	16.2	*14.66*	6.1	8.8	*7.06*	66.6	68.9	*67.57*	.6	1.2	*.86*	2.00
Rye Flour	4	86.4	87.7	*86.90*	6.0	7.1	*6.65*	.8	.9	*.84*	77.6	79.1	*78.28*	.4	.5	*.41*	.72
Wheat Flour, from Winter Wheat*	1	....	....	*87.04*	....	....	*8.56*	....	....	*1.19*	....	....	*76.59*	....	....	*.17*	.53
" from Spring Wheat†	6	86.5	89.7	*87.68*	8.6	14.1	*10.68*	.6	2.0	*1.11*	68.3	78.1	*75.00*	....	1.2	*.22*	.64
" Unclassified	21	86.4	88.8	*87.52*	9.7	13.3	*11.25*	.8	1.9	*1.16*	69.5	76.9	*74.33*	.1	1.0	*.25*	.53
" Average of all varieties	25	86.4	89.7	*87.44*	8.6	14.1	*11.28*	.6	2.0	*1.20*	68.3	78.1	*74.13*	.0	1.2	*.27*	.56
Graham Flour	3	86.3	87.9	*86.90*	11.3	12.4	*11.70*	1.5	1.9	*1.70*	69.8	70.0	*69.80*	1.8	2.1	*1.90*	1.80
Maize Meal	49	75.5	92.0	*84.81*	7.1	10.3	*9.20*	2.2	5.1	*3.85*	60.6	74.0	*68.39*	.5	2.8	*1.89*	1.48
Hominy	2	86.4	86.6	*86.50*	8.1	8.4	*8.25*	.4	.5	*.44*	77.1	77.2	*77.12*	.3	.3	*.32*	.38
Sorghum Meal, mostly decorticated	1	....	....	*86.84*	....	....	*8.25*	....	....	*3.85*	....	....	*71.27*	....	....	*1.88*	1.59
Pea Meal	1	....	....	*87.92*	....	....	*21.37*	....	....	*.86*	....	....	*52.02*	....	....	*11.06*	2.61

* The average of 18 analyses, most of them incomplete, is: Total dry matter, 89.63; Ash, .64; Albuminoids, 10.92.

† The average of 16 analyses, most of them incomplete, is: Total dry matter, 88.55; Ash, .60; Albuminoids, 11.63.

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extr.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
BY-PRODUCTS AND REFUSE.																	
Apple Pomace	5	17.5	27.4	*22.51*	1.0	1.7	*1.37*	.6	2.0	*1.39*	12.6	17.0	*15.04*	2.3	5.9	*4.19*	.52
Brewers' Grains, wet from Brewery	15	20.6	31.4	*24.99*	4.3	7.7	*5.57*	.8	2.9	*1.68*	10.1	15.7	*12.86*	3.0	5.6	*3.87*	1.01
" " Dried "	3	88.1	93.8	*91.81*	19.2	20.2	*19.89*	4.2	6.5	*5.56*	46.1	56.8	*51.75*	10.2	11.6	*11.01*	3.58
" Kiln-dried	1	....	....	*97.43*	....	....	*20.30*	....	....	*6.40*	....	....	*54.89*	...	....	*11.79*	3.97
" From Silo	3	26.1	33.2	*30.18*	5.8	7.1	*6.64*	1.8	2.5	*2.11*	13.6	16.8	*15.58*	3.9	5.4	*4.64*	1.21
Brewers' Swill	1	....	....	*5.70*	....	....	*1.90*	....	....	*.80*	....	....	*2.00*	....	....	*.70*	.30
Malt Sprouts	3	88.0	92.7	*89.72*	21.0	25.9	*22.95*	1.1	2.9	*1.79*	45.4	50.3	*48.60*	9.3	11.9	*10.72*	5.67
Cotton Seed Meal	24	81.5	94.2	*91.67*	23.3	50.8	*42.06*	10.2	18.0	*13.24*	12.7	38.6	*23.43*	2.7	11.7	*5.69*	7.25
Linseed Cake	4	89.2	91.6	*89.98*	31.8	34.9	*33.77*	4.0	6.1	*5.04*	33.4	39.1	*36.68*	7.9	9.3	*8.52*	5.97
Linseed Meal, Old Process	9	87.4	93.8	*90.80*	27.7	34.0	*31.53*	5.1	11.6	*7.78*	31.3	41.9	*36.34*	7.1	12.9	*9.26*	5.87
" New Process	12	86.6	93.2	*89.25*	27.1	37.1	*32.85*	1.3	4.4	*3.08*	35.2	48.0	*38.29*	7.6	14.0	*9.46*	5.57
" Oil not removed	1	....	....	*91.67*	....	...	*22.97*	....	....	*30.26*	....	....	*25.48*	...	....	*9.60*	3.36
Palm Nut Meal	3	89.1	93.8	*91.71*	13.5	16.0	*14.39*	6.4	18.7	*13.30*	33.8	41.6	*38.88*	18.7	23.9	*21.40*	3.74
Rye Bran	5	86.3	91.8	*88.52*	12.6	16.8	*15.39*	1.8	2.8	*2.47*	59.8	67.6	*63.42*	2.5	4.1	*3.56*	3.68
Wheat Bran	52	84.2	91.8	*87.58*	7.5	16.9	*15.03*	1.5	5.9	*3.74*	45.5	63.1	*54.17*	2.4	17.8	*8.96*	5.68
Wheat Middlings	23	84.0	91.5	*88.04*	10.1	19.2	*14.87*	2.1	5.9	*3.89*	53.0	70.9	*61.55*	1.3	12.7	*4.55*	3.18
Wheat Shorts	8	84.5	89.0	*87.26*	11.1	16.1	*13.83*	2.5	5.3	*4.14*	53.3	67.0	*57.59*	5.8	10.5	*7.45*	4.25
"Hominy Chops," "Hominy Feed," Baltimore Meal," "White Meal"	11	86.5	91.9	*88.86*	7.9	11.2	*9.85*	4.6	11.2	*8.43*	61.0	71.1	*64.49*	2.5	4.8	*3.59*	2.50
Gluten Meal	8	88.3	92.7	*90.85*	25.0	35.0	*29.88*	4.2	8.7	*6.11*	44.7	58.5	*52.62*	.7	3.3	*1.46*	.78
Maize Cob	13	85.6	92.8	*90.67*	1.2	3.7	*2.50*	.1	.9	*.47*	45.3	66.4	*55.99*	28.2	38.2	*30.36*	1.33
"Starch Feed," refuse from starch manuf.	8	27.8	37.7	*34.34*	3.6	7.7	*5.73*	1.3	4.3	*3.02*	18.7	28.9	*22.21*	1.6	4.3	*3.17*	.31
Sugar Feed, refuse from glucose manuf.	2	89.6	93.4	*91.50*	13.1	13.5	*13.30*	5.9	11.2	*8.60*	54.9	61.4	*58.10*	8.4	10.7	*9.50*	2.00
Sorghum Bagasse	3	11.3	16.6	*14.50*	.6	.7	*.65*	....	....	....	....	....	*10.20*	2.8	3.3	*3.10*	.60

amides or amido-acids. These bodies have a different percentage composition from albuminoids, differ from them in their properties and very considerably in their nutritive value. They are closely related to the albuminoids, and may be derived from or assist in producing the latter.

Other nitrogenous substances which are sometimes found in certain feeding stuffs, generally in very small quantity however, are peptones, alkaloids, nitrates and ammonia salts. The last three are without any nutritive effect on animals so far as is known.

Crude Fat includes fat oil, solid fat, wax, chlorophyl (the green coloring matter of plants,) and other coloring matters, in brief everything which can be extracted from the perfectly dry feeding stuff by absolute ether.

Nitrogen-free Extract, sometimes called *Carbhydrates* includes starch, gum, sugar and pectin bodies. They are readily extracted from the feeding stuff by water and dilute acid but their amount is always indirectly determined by subtracting the sum of the albuminoids, fiber, fat and ash from the total dry matter.

Fiber or *Cellulose* is the essential constituent of the walls of vegetable cells and is seen in a nearly pure state in cotton fiber or paper pulp. It is the most insoluble part of the vegetable substance and its quantity is determined by boiling the feeding stuff successively with a weak acid and a weak alkali, and after copious washing with water, extracting the residue with alcohol and ether. This treatment leaves undissolved what is properly called Crude Fiber which is Cellulose in a state of comparative purity.

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air and besides a little charcoal and sand, which are accidental impurities, consists chiefly of lime, magnesia, potash and soda, combined with chlorine and carbonic, sulphuric and phosphoric acids.

The methods of fodder analysis are, in some respects, still very imperfect, as will be inferred by what has been said with regard to the albuminoids. The results, however, have proven themselves of great value in farm practice which is the best gauge of utility and will be used until more satisfactory methods can be devised.

USE OF THE TABLES OF COMPOSITION OF FEEDING STUFFS.

These tables are designed to be a help in forming an estimate of the composition of feeding stuffs which for any reason cannot be specially submitted to chemical analysis. It follows that judgment is necessary in their use. All feed and particularly all coarse feed varies considerably in quality. The first thing to decide is whether the feed in question is in fair condition. If coarse fodder, was it raised on poor land or not, was it cut early or late, was it harvested in good order, is it clean and sweet or not? The answers to these questions will decide whether the average composition of that kind of feed can be fairly attributed to the article in hand. If it cannot be, the maximum and minimum figures will indicate how much allowance is to be made in extreme cases for a specially good or unusually poor condition of the feed.

A determination of albuminoids or of albuminoids and crude fiber will greatly assist in the estimate, and it will rarely happen that such determinations cannot be made within a few days if the sample is sent to the Station with notice that results are wanted for immediate use. Concentrated foods, grain, bran, etc., it will be observed, vary much less in composition than coarse fodder. In any case the quality of the feed should be underestimated rather than overestimated.

II. THE DIGESTIBILITY OF FEEDING STUFFS.

When food is received into the stomach a portion of it is dissolved and otherwise altered by the juices of the mouth, stomach and intestines, is then taken up from the alimentary canal and in the form of chyle passes into the blood and becomes a part of the juices or tissues of the body. This portion is said to be digested and assimilated and from it alone the animal is nourished. The other portions pass through the body and are excreted as dung. The urine removes from the body only certain waste products which are formed from the digested or assimilated food.

The analysis of a feeding stuff, as has been said, divides its constituents into several groups, albuminoids, fat, etc., each group may contain a number of similar substances, some of which or portions of which are soluble in the juices of the digestive organs, i. e. are digestible, while others are not soluble, or are indigestible.

As only the soluble or digestible portion of the feeding stuff is of any nutritive use to the animal, it is essential, in order to feed rationally that it should be known of each feeding stuff what part of its albuminoids, fat, and other ingredients—the total quantity of which is given by the analysis—is actually digested by the animal. This is learned by feeding trials upon a number of animals. In the case of coarse fodders which can make up the entire ration during the period of experiment, the food consumed and the dung excreted are both very carefully weighed and analyzed and from their quantities and composition it is calculated how much albuminoids, nitrogen-free extract, fiber, etc., was eaten by the animal, and how much of these several materials was voided, the difference being what was digested and served as actual nourishment. The digestibility of concentrated fodders is determined in the same way, the process being somewhat complicated and the results probably made a little less accurate because the concentrated foods cannot be fed by themselves but must be administered in connection with a coarse fodder whose digestibility has already been determined.

Many practical trials have been made, chiefly at German experiment stations, to determine accurately the digestibility of the feeding stuffs commonly in use. The larger number of trials were made with cattle and sheep, some also with horses and swine. Some of the results of these trials are given in the following table of the Digestibility of Feeding Stuffs or of Digestion Coefficients. This is made up in large part from the one given in Mentzel and Lengerke's Landw. Kalender, 1885. Use has also been made of the tables in Dr. H. P. Armsby's Manual of Cattle Feeding. The arrangement of the table is simple. Thus the figure 3 after pasture grass in the first column signifies the number of distinct lots of pasture grass which were tested. In the next column 6 means that with the three separate lots of pasture grass six distinct feeding experiments were made with ruminating animals: sheep, cows and oxen. The greater the number of experiments and lots of grass tested, the more accurately will the average digestibility be determined. 77 in the fifth column indicates that of the dry organic substance contained in pasture grass, the ruminants digest on the average 77 per cent. or $\frac{770}{1000}$, while the maximum and minimum figures 78 and 75 mean that one of the three samples of hay tested had but 75 per cent. and another had as high as 78 per cent. of its organic substance digested. By use of the information given in the tables of the Composition and the Digestibility of Feeding Stuffs it is easy for the farmer to ascertain with reasonable accuracy how much real nutriment is at his disposal for stock feeding.

A single example may illustrate. It is required to know how much digestible food is contained in a ton of wheat bran. By reference to the table of Composition of Feeding Stuffs it is seen that 100 parts of wheat bran contain on the average:

Dry matter	87.58
Albuminoids	15.03
Fat	3.74
Nitrogen-free extract	54.17
Fiber	8.96
Ash	5.68

The table of the Digestibility of Feeding Stuffs shows that in wheat bran about

78 per cent. of the albuminoids,
69 per cent. of the fat,
77 per cent. of the nitrogen-free extract,
33 per cent. of the fiber,

are digested by oxen.

Multiplying the total amounts of the different constituents as expressed in per cent. or pounds per hundred by their percentage digestibility or "digestion coefficients" gives the actual amounts of digestible matter in 100 pounds of the bran, and this again multiplied by 20 will give the amounts of *digestible* albuminoids, fat, etc., in 2000 pounds or one ton.

Digestible albuminoids	15.03 × .78 = 11.72 × 20 = 234.4	lbs.
Digestible fat	3.74 × .69 = 2.58 × 20 = 51.6	"
Digestible N.-free extract	54.17 × .77 = 41.71 × 20 = 834.2	"
Digestible fiber	8.96 × .33 = 2.95 × 20 = 39.0	"

By precisely the same method the actual nutriment of all the feeding stuffs used may be determined with sufficient accuracy.

The next step is to compound from these materials a ration which shall supply the animal with sufficient but not a wasteful excess of the different kinds of nutriment. With regard to the use of these various nutrients in the animal body it may be said that the albuminoids have a different physiological significance from fiber and the nitrogen-free extract, which latter consists of starch, the sugars, the gums and similarly constituted matters.

Albuminoids may easily be made over by the animal into its own substance, i. e., into muscles, tendons and the various working tissues and membranes because these necessary parts of the animal machine are themselves made up of the same kind of materials, or, chemically speaking, have the same composition as the albuminoids.

Fiber and the nitrogen-free extract on the other hand, probably cannot serve at all for building up the muscles and other parts of

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients.)

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
GREEN FODDER.																	
Pasture grass	3	6	75	78	*77.*	72	79	*75.*	63	69	*66.*	75	84	*78.*	72	80	*75.*
Meadow grass [experiments with horses]	10	13	43	62	*50.*	54	69	*61.*	9	42	*21.*	49	66	*57.*	33	57	*41.*
Meadow rowen	6	30	62	71	*64.*	61	68	*62.*	31	56	*46.*	63	74	*66.*	59	68	*64.*
Pasture clover, very young	1	2	..	..	*75.*	..	..	*78.*	..	..	*64.*	..	..	*78.*	..	..	*67.*
Red clover, just before blossoming	6	15	59	74	*66.*	60	76	*66.*	58	74	*64.*	63	83	*73.*	47	60	*53.*
Lucerne, before flowering and in flower	9	28	55	67	*60.*	67	83	*74.*	29	55	*39.*	61	73	*67.*	34	48	*43.*
Vetches*	..	..	..	..	..	73	80	*76.*	50	66	*60.*	63	67	*65.*	51	58	*54.*
Lupines*	..	..	..	..	..	73	76	*74.*	16	45	*30.*	57	66	*62.*	67	80	*73.*
Maize fodder (very good)	1	1	..	..	*70.*	..	..	*73.*	..	..	*75.*	..	..	*67.*	..	..	*72.*
Sorghum	1	1	..	..	*73.*	..	..	*62*	..	..	*85.*	..	..	*78.*	..	..	*59.*
Beet leaves [ensilaged]	1	2	..	..	*57.*	..	..	*65.*	..	..	*60.*	..	..	*54.*	..	..	*54.*
Beans, peas, cabbage, turnip leaves, parsnip leaves	..	..	.	..	..	..	..	*71.*	..	..	*60.*	..	..	*100†*	..	..	..
Fodder rye, fodder oats, beet leaves, carrot leaves, buckwheat	..	..	..	..	..	..	..	*58.*	..	..	*46.*	..	..	*100†*	..	..	..
HAY.																	
Meadow hay	38	104	46	71	*62*	42	72	*62.*	10	63	*52.*	49	76	*64.*	46	71	*57.*
Meadow hay (very good)	14	42	56	71	*65.*	57	70	*64.*	31	63	*50.*	58	76	*68.*	55	71	*62.*
Meadow hay (medium)	24	62	46	69	*60.*	42	72	*57.*	10	63	*48.*	49	73	*62.*	[illegible]	66	*58.*

* These coefficients were obtained in experiments with very good hay of these plants but are approximately correct for the green fodder.

† The number 100 indicates that the sum of the digestible extract and fiber is equal to the total amount of nitrogen-free extract.

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
HAY—*continued.*																	
Meadow hay (inferior)	7	18	46	59	*55.*	42	56	*51.*	10	57	*41.*	49	61	*58.*	46	61	*54.*
Meadow hay (very good, experiments on horse)	3	4	49	55	*52.*	63	66	*64.*	14	42	*24.*	52	62	*57.*	36	46	*43.*
Meadow hay (medium, experiments on horse)	5	6	43	51	*48.*	54	62	*58.*	16	33	*23.*	49	61	*55.*	33	40	*37.*
Clover hay [very good]	6	12	58	63	*61.*	55	69	*62.*	44	72	*60.*	67	72	*70.*	39	52	*47.*
Clover hay (medium)*	6	19	54	62	*57.*	43	61	*55.*	35	70	*51.*	58	67	*65.*	39	52	*45.*
Clover hay (experiments on horse)	4	6	49	55	*51.*	51	60	*56.*	28	31	*29.*	61	67	*64.*	35	39	*37.*
Lucerne hay (very good)	9	28	55	67	*60.*	67	83	*74.*	29	55	*39.*	61	73	*66.*	34	48	*43.*
Hay of fodder vetches [before blossom]	1	6	--	--	*65.*	--	--	*76*	--	--	*60.*	--	--	*66.*	--	--	*54.*
Lupine hay, in blossom	1	2		--	--	--	--	*74.*	--	--	*30.*	--	--	*62.*	--	--	*74.*
ROOTS.																	
Potatoes	3	23	83	90	*88.*	64	67	*65.*	--	--	--	89	96	*93.*	--	--	--
Potatoes [experiments with pigs]	5	8	--	--	*93.*	--	--	*73.*	--	--	--	--	--	*98.*	--	--	*55.*
Sugar beets	2	28	84	93	*89.*	56	68	*62.*	--	--	--	95	96	*95.*	--	--	--
Mangolds	2	16	87	88	*88.*	66	86	*76.*	--	--	--	94	96	*95.*	--	--	--
Turnips	1	8	--	--	*78.*	--	--	*57.*	--	--	--	--	--	*89.*	--	--	--
GRAINS.																	
Oats	6	31	62	74	*68.*	68	86	*77.*	75	97	*82.*	67	79	*74.*	0	26	*17.*
Oats (experiment with horse)	1	5	--	--	*72.*	--	--	*86.*	--	--	*78.*	--	--	*76.*	--	--	*24.*
Barley	1	2	--	--	*81.*	--	--	*77.*	--	--	*100.*	--	--	*87.*	--	--	--

Digestibility of Feeding Stuffs (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
Grains—*continued.*																	
Barley (experiment with horse)	1	1	--	--	*87.*	--	--	*80.*	--	--	*42.*	--	--	*87.*	--	--	*100.*
Barley (experiments with pig)	4	8	82	85	*83.*	75	80	*78.*	65	77	*68.*	89	91	*90.*	0	27	*12.*
Maize	1	2	--	--	*89.*	--	--	*79.*	--	--	*85.*	-	--	*91.*	--	--	*62.*
Maize (experiment with horse)	1	1	--	--	*91.*	--	-	*78.*	--	--	*63.*	--	--	*94.*	--	--	*100.*
Maize (experiments with pig)	3	4	90	95	*92.*	84	88	*86.*	76	77	*76.*	93	96	*95.*	19	57	*40.*
Field beans	5	18	83	94	*89.*	81	95	*88.*	65	100	*87.*	88	95	*92.*	25	92	*72.*
Field beans (experiments with horse)	1	4	--	--	*87.*	--	--	*86.*	--	--	--	--	--	*93.*	--	--	*69.*
Peas	1	2	--	--	*90.*	--	--	*89.*	--	--	*75.*	--	--	*93.*	--	--	*66.*
Peas (experiment with horse)	1	1	--	--	*80.*	--	--	*83.*	--	--	*67.*	--	--	*89.*	--	--	*8.*
Peas (experiments with pigs)	5	10	88	95	*91.*	85	90	*88.*	36	67	*49.*	95	99	*96.*	55	89	*71.*
By-Products and Refuse.																	
Wheat bran (fed dry)	5	12	67	78	*72.*	71	89	*78.*	50	80	*69.*	70	82	*77.*	20	39	*33.*
Rye bran (experiments with pigs)	1	2	--	--	*67.*	--	--	*66.*	--	--	*58.*	--	--	*75.*	--	--	*4.*
Malt sprouts	1	3	--	--	*84.*	--	--	*82.*	--	--	*49.*	--	.	*88.*	--	..	*95.*
Brewers' grains	1	2	--	--	*63.*	--	--	*73.*	--	--	*84.*	--	--	*64.*	--	--	*39.*
Rape meal (oil extracted)	1	1	--	--	*6[illegible].*	--	--	*84*	--	--	--	--	--	*85.*	--	--	--
Rape cake	2	7	56	75	*66.*	76	86	*81.*	69	88	*79.*	74	78	*76.*	0	16	*8.*
Linseed meal (oil extracted)	1	8	--	--	*71.*	--	--	*82.*	--	--	*91.*	--	--	*73.*	--	--	--
Linseed cake	2	10	78	83	*81.*	84	87	*86.*	89	91	*90.*	70	91	*80.*	26	62	*44.*

DIGESTIBILITY OF FEEDING STUFFS (Digestion Coefficients)—*Continued.*

	Number of samples tested.	Number of experiments.	Total dry organic matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free extract.			Fiber.		
			Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
BY-PRODUCTS AND REFUSE—*continued.*																	
Palm-nut meal (oil extracted)	2	3	89	93	*91.*	89	100	*95.*	89	100	*95.*	92	96	*94.*	72	92	*82.*
Cotton-seed cake (decorticated)	1	2	--	--	*80.*	--	--	*85.*	--	--	*88.*	--	--	*95.*	--	--	--
Cotton-seed cake (not decorticated)	1	4	--	--	*50.*	--	--	*73.*	--	--	*91.*	--	--	*46.*	--	--	*23.*
Cocoanut cake	1	2	--	--	*78.*	--	--	*76.*	--	--	*100.*	--	--	*81.*	--	--	*62.*
Cocoanut cake [experiments with pigs]	1	2	--	--	*80.*	--	--	*74.*	--	--	*83.*	--	--	*89.*	--	--	*60.*
Flesh meal	1	2	--	--	*95.*	--	--	*95.*	--	--	*98.*	--	--	--	--	--	--
Flesh meal [experiments with pigs]	1	8	--	--	*95.*	--	--	*97.*	--	--	*87.*	--	--	--	--	--	--
Blood meal	1	2	--	--	*63.*	--	--	*62.*	--	--	*100.*	--	--	*100.*	--	--	--
Blood meal [experiments with pig]	1	1	--	--	*72.*	--	--	*72.*	--	--	--	--	--	*92.*	--	--	--
Fish guano	1	2	--	--	--	--	--	*90.*	--	--	*76.*	--	--	--	--	--	--
STRAW.																	
Wheat straw*	2	3	45	48	*46.*	8	26	*17.*	27	44	*36.*	37	40	*39.*	52	59	*56.*
Wheat straw [experiments with horse]	1	2	--	--	*23.*	--	--	*19.*	--	--	*49.*	--	--	*17.*	--	--	*27.*
Rye straw	2	9	42	51	*46.*	17	25	*21.*	--	--	*32.*	35	38	*37.*	49	70	*60.*
Oat straw	4	8	48	56	*51.*	24	48	*41.*	20	49	*30.*	39	45	*46.*	55	64	*60.*
Barley straw	2	5	51	55	*53.*	17	24	*20.*	41	43	*42.*	51	57	*54.*	55	56	*56.*
Pea straw (very good)	1	2	--	--	*59.*	--	--	*61.*	--	--	*46.*	--	--	*64.*	--	--	*52.*
Bean straw*	1	3	--	--	*50.*	--	--	*51.*	--	--	*55.*	--	--	*63.*	--	--	*36.*
Lupine straw	1	2	--	--	*55.*	--	--	*37.*	--	--	*30.*	--	--	*65.*	--	--	*51.*

the growing animal and cannot restore the waste and wear of those parts of mature animals, because they are of a very different nature. They contain no nitrogen, an element which enters into all the animal tissues (albuminoids) to the extent of some sixteen per cent. of their dry matter.

Fiber and the N.-free extract cannot restore the worn out muscles or membranes of the animal any more than coal can be made to renew the used-up packing, bolts, valves, flues and gearing of a steam-engine. Albuminoids are to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

Fat, fiber and N.-free extract are, furthermore, to the animal very much what coal and fuel are to the steam-engine. Their consumption generates the power which runs the mechanism. Their burning (oxidation) in the blood of animals produces the results of life just as the combustion of coal in the fire-place of the steam-engine produces the motion and power of that machine.

There is, however, this difference between the engine and the animal: the former may be stopped for repairs, the latter may run at a lower rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its wastes. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed not only with coal and water, but with iron, brass and all the materials for its repair, and also is as if the engine consumed its own worn out parts, voiding them as ashes or as gas and smoke. Albuminoids or the blood- and tissue-formers are thus consumed in the animal, as well as the fat, fiber and N.-free extract or fuel proper. The fact that albuminoids admit of consumption implies that when the proper fuel is insufficient, they may themselves serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has demonstrated, that for each special case of animal nutrition a special ratio of digestible albuminoids to digestible fat, fiber and N.-free extract is the best and most economical, and, within certain limits, is necessary. This proportion we designate as the *nutritive ratio*, and these explanations make its significance evident.

It is believed that the digestible parts of fiber and of N.-free extract (i. e., of starch, sugar, and gums), have about the same nutritive value, i. e. answer essentially the same purposes in the body. The fat, however, has a greater value, formerly assumed to be two and a half times that of fiber and N.-free extract. This assumption is not entirely justified by our present knowledge, yet for the sake of uniformity and to avoid confusion, that factor must be retained till a more satisfactory one is agreed upon.

The rule then to determine the nutritive ratio in any feeding stuff or ration is to add together the amounts of digestible fiber and N.-free extract, and the amount of digestible fat multiplied by 2½ and divide that sum by the amount of digestible albuminoids.

To illustrate: the nutritive ratio of the wheat bran, whose digestible nutrients are given above, is calculated as follows:

Digestible fiber	2.95
" nitrogen-free extract	41.71
" fat (2.58 × 2½)	6.45
	51.11

51.11 ÷ 11.72 (digestible protein) = 4.36

Thus the nutritive ratio of wheat bran is 1 : 4.36.

III. FEEDING STANDARDS.

In the last paragraphs a comparison has been made between the animal and a steam engine. It is evident that the engine must be fed with sufficient fuel of a kind adapted for use in its furnace, and besides this, to run it economically the amount of fuel and the rate of feeding it must be adapted to the work to be performed. If the engine is simply standing in readiness, with steam up, a very little fuel will do, if it is propelling a locomotive and approaching a steep grade with a heavy train the consumption of fuel must be enormously increased. The same holds with the animal machine: the amount of food must be suited to the performance required.

But the locomotive engine does a single kind of work; domestic animals on the contrary do several kinds—they produce beside animal heat, either flesh, milk, wool or muscular energy.

Not only is the total amount of food required for these various kinds of production different but, as experience proves, different proportions of the various digestible food-elements or nutrients are required to yield fat mutton than are needed to produce milk, or to sustain labor, or to keep the resting animal in fair condition;

and again the most suitable milk-producing ration is not the one best adapted for the growth of wool.

A careful observant feeder of cattle by long trial can ascertain with approximate correctness in what quantity and proportion he may most profitably use the feeding stuffs which are at his com-

TABLE OF FEEDING STANDARDS.

A. POUNDS PER DAY PER 1,000 POUNDS LIVE WEIGHT.

KIND OF ANIMAL.	Total organic matter.	Albuminoids or Protein.	Nitrogen-free extract and fiber.	Fat.	Total nutritive substances.	Nutritive ratio.
Horse at light work	21.0	1.5	9.5	0.40	11.40	1 : 7.0
" average work	22.5	1.8	11.2	0.60	13.60	1 : 7.0
" hard work	25.5	2.8	13.4	0.80	17.00	1 : 5.5
Oxen at rest in stall	17.5	0.7	8.0	0.15	8.85	1 : 12.0
" ordinary work	24.0	1.6	11.3	0.30	13.20	1 : 7.5
" hard work	26.0	2.4	13.2	0.50	16.10	1 : 6.0
Oxen fattening, first period	27.0	2.5	15.0	0.50	18.00	1 : 6.5
" " second "	26.0	3.0	14.8	0.70	18.50	1. 5.5
" " third "	25.0	2.7	14.8	0.60	18.10	1 : 6.0
Milk Cows	24.0	2.5	12.5	0.40	15.40	1 : 5.4
Sheep, wool-producing (coarser breeds)	20.0	1.2	10.3	0.20	11.70	1 : 9.0
" wool-producing (finer breeds)	22.5	1.5	11.4	0.25	13.15	1 : 8.0
" fattening, first period	26.0	3.0	15.2	0.50	18.70	1 : 5.5
" " second "	25.0	3.5	14.4	0.60	18.50	1 : 4.5
Swine, fattening, first period	36.0	5.9	27.5		32.50	1 : 5.5
" " second "	31.0	4.9	24.0		28.00	1 : 6.0
" " third "	23.5	2.7	17.5		20.20	1 : 6.5
GROWING CATTLE.						
Age. Months. Average live weight per head.						
2–3 150 pounds	22.0	4.0	13.8	2.0	19.8	1 : 4.7
3–6 300 "	23.4	3.2	13.5	1.0	17.7	1 : 5.0
6–12 500 "	24.0	2.5	13.5	0.6	16.6	1 : 6.0
12–18 700 "	24.0	2.0	13.0	0.4	15.4	1 : 7.0
18–24 850 "	24.0	1.6	12.0	0.3	13.9	1 : 8.0
GROWING SHEEP.						
5–6 56 pounds	28.0	3.2	15.6	0.8	19.6	1 : 5.5
6–8 67 "	25.0	2.7	13.3	0.6	16.6	1 : 5.5
8–11 75 "	23.0	2.1	11.4	0.5	14.0	1 : 6.0
11–15 82 "	22.5	1.7	10.9	0.4	13.0	1 : 7.0
15–20 85 "	22.0	1.4	10.4	0.3	12.1	1 : 8.0
GROWING PIGS.						
2–3 50 pounds	42.0	7.7	30.0		37.5	1 : 4.0
3–5 100 "	34.0	5.5	25.0		30.0	1 : 5.0
5–6 125 "	31.5	4.3	23.7		28.4	1 : 5.5
6–8 170 "	27.0	3.4	20.4		23.8	1 : 6.0
8–12 250 "	21.0	2.5	16.2		18.7	1 : 6.5

TABLE OF FEEDING STANDARDS—*Continued.*

B. POUNDS PER DAY PER HEAD.

KIND OF ANIMAL.		Total organic matter.	Albuminoids or Protein.	Nitrogen-free extract and fiber.	Fat.	Total nutritive substances.	Nutritive ratio.
	GROWING CATTLE.						
Age. Months.	Average live weight per head.						
2–3	150 pounds........	3.3	0.6	2.1	0.30	3.00	1 : 4.7
3–6	300 "	7.0	1.0	4.1	0.30	5.40	1 : 5.0
6–12	500 "	12.0	1.3	6.8	0.30	8.40	1 : 6.0
12–18	700 "	16.8	1.4	9.1	0.28	10.78	1 : 7.0
18–24	850 "	20.4	1.4	10.3	0.26	11.96	1 : 8.0
	GROWING SHEEP.						
5–6	56 pounds........	1.6	0.18	0.87	0.045	1.095	1 : 5.5
6–8	67 "	1.7	0.17	0.85	0.040	1.060	1 : 5.5
8–11	75 "	1.7	0.16	0.85	0.037	1.047	1 : 6.0
11–15	82 "	1.8	0.14	0.89	0.032	1.062	1 : 7.0
15-20	85 "	1.9	0.12	0.88	0.025	1.047	1 : 8.0
	GROWING PIGS.						
2–3	50 pounds........	2.1	0.38	1.50		1.88	1 : 4.0
3–5	100 "	3.4	0.50	2.50		3.00	1 : 5.0
5–6	125 "	3.9	0.54	2 96		3.50	1 : 5.5
6–8	170 "	4.6	0.58	3.47		4.05	1 : 6.0
8–12	250 "	5.2	0.62	4.05		4.67	1 : 6.5

mand. His results may be adopted by his neighbors with profit provided that their feeding materials are of the same kind and of the same quality, but if their feed is different, if one is using early cut hay, the other late cut hay, if one uses corn meal, the other wheat bran, if one has mangolds at his disposal, the other not, then the valuable experience of the one is of comparatively little use to the other. Some common standard of comparison is necessary in order to make the experience of one readily available for others. The best means of comparison as yet realized, is furnished by the table of Feeding Standards taken in connection with the other tables which have been already explained.

This Table expresses the average result of many carefully conducted experiments with cattle in which the quantity of the food used and the material produced by the animals, whether beef, milk or wool, were all accurately and repeatedly determined. The table involves no guess-work or speculation, but is to be regarded simply as a convenient and concise way of expressing the general results of the best practical experience in feeding cattle. Like all such general statements it must be used intelligently to be of any value. The special circumstances of the feeder, the ruling prices of the different articles of feed used, the individual peculiarities of his stock, all have to be considered and all may have a modifying effect on the composition or effect of the ration.

These tables and explanations are not substitutes for common sense or experience in feeding, but are helps to them.

A single example may here be given to illustrate the method of using the tables :

There are available for feeding a herd of milk cows, a rather short allowance of Timothy hay, plenty of wheat straw and turnips, while brewers' grains can be got fresh daily at a low price. It is first to be determined about how much digestible matter these feeding stuffs contain. From the Table of Average Composition, their probable percentage amount of albuminoids, fat, etc., can be learned, and from the Table of Digestibility is found what proportion is to be regarded as digestible. The calculation is as follows :—

TIMOTHY HAY.	Pounds per hundred.		Per cent. digestible.		Pounds per hundred digestible.
Organic matter*	84.87				
Albuminoids	6.02	×	57†	=	3.43
Fat	2.16	×	48	=	1.04
N.-free Extract	45.82	×	62	=	28.41
Fiber	30.89	×	58	=	17.91
WHEAT STRAW.					
Organic matter	86.54				
Albuminoids	4.98	×	17	=	.84
Fat	1.49	×	36	=	.53
N.-free Extract	41.99	×	39	=	16.37
Fiber	38.08	×	56	=	21.32
TURNIPS.					
Organic matter	10.40				
Albuminoids	1.34	×	57	=	.77
Fat	.09‡				.09
N.-free Extract	8.11	×	89	=	7.22
Fiber	.86‡				.86
BREWERS' GRAINS.					
Organic matter	23.98				
Albuminoids	5.57	×	73	=	4.06
Fat	1.68	×	84	=	1.41
N.-free Extract	12.86	×	64	=	8.23
Fiber	3.87	×	39	=	1.51

---

* Dry matter less the ash.

† These are the digestion coefficients of medium meadow hay.

‡ Regarded as wholly digestible.

The Table of Feeding Standards gives as the average ration for milk cows—*per* 1000 *pounds live weight*:—

Total Organic matter	24.0	pounds
Digestible Albuminoids	2.5	"
" N.-free Extract*	12.5	"
" Fat	0.4	"
Nutritive ratio	1 : 5.4	"

* Including digestible fiber.

A few preliminary calculations may bring us to somethin the following ration :—

	Organic matter, pounds.	Albuminoids, pounds.	Fat, pounds.	N.-free Extract pounds.	F po
9 pounds hay, containing digestible,	7.6	.31	.09	2.56	1
10 " straw, " "	8.7	.08	.05	1.64	2
20 " turnips, " "	2.1	.15	.02	1.44	
20 " brewers' grains, "	4.8	.81	.28	1.64	
Total,	23.2	1.35	.44	7.28	4

Comparing this ration with the Standard it has a littl organic matter, over one pound less albuminoids and nitroge extract (7.28+4.21=11.49), and the nutritive ratio is quite viz. 1 : 9.3. Perhaps the ration under some circumstances be economical. It needs the addition of some concentrate rich in albuminoids and N.-free extract, but poor in fat. L over the table of average composition of feeding stuffs, ne cess linseed meal seems to answer that description.

Calculating the amount of digestible food in it as in th just given it appears that four pounds of it will bring the d ble albuminoids of the ration up to the Standard.

	Organic matter.	Albuminoids.	Fat.	Extract.	N.-f Fib
Already in the ration	23.2	1.35	.44	7.28	4.2
4 pounds new process linseed meal	3.3	1.08	.11	1.12	
Total	26.5	2.43	.55	8.40	4.2
				12.61	
Feeding Standard	24.0	2.50	.40	12.50	

In this ration we have 2.5 pounds more organic matter pounds more digestible fat than the Standard calls for, while tible albuminoids and nitrogen-free extract agree quite with the Standard. The nutritive ratio is 1 : 5.8.

It will be observed that the ration is calculated for 1000 *pounds live weight* and must be brought to correspond with the weight of the cows.

ANALYSES OF FEEDING STUFFS.

Buckwheat Mill Products.

The three following samples were sent by the Quinnebaug store, Danielsonville. They are stated to represent the products of a new milling process there in operation.

CCXII. Buckwheat Hulls.

CCXIII. Buckwheat Bran or Middlings.

CCXV. Buckwheat Flour.

	Buckwheat Hulls. CCXII.	Buckwheat Middlings. CCXIII.	Buckwheat Flour. CCXV.
Water	14.07	16.33	17.63
Ash	2.27	5.50	.83
Albuminoids or Protein	4.87	30.31	8.13
Fiber	38.49	4.02	.52
Nitrogen-free extract	39.20	36.29	71.10
Crude Fat	1.10	7.55	1.79
	100.00	100.00	100.00

The Hulls have very little feeding value, considerably less than wheat or rye straw. The digestibility of their albuminoids is probably less than that of straw. As regards its chemical composition the Flour is of superior quality. The bran or Middlings is remarkable, being a much more concentrated food than wheat bran and more nearly resembling gluten meal or linseed meal in its content of albuminoids or protein and fat. It should be used at first with great caution, but may prove to be an excellent feed if produced in sufficient quantity.

Oat Feed.

CCXXXV. Oat feed. Sampled and sent by Benj. F. Case, Canton Center.

Mr. Case says: "It is said to be the product of an oatmeal mill where they can use none but strictly No. 1 oats that are perfectly sweet, which are thoroughly cleaned and dried before crushing. I consider it one of the economical feed stuffs to make up a ration for horses, milk cows and young calves."

The analysis shows that this material has about 1½ per cent. more of albuminoids, a per cent. more of fat, 3½ per cent. more fiber and 4¾ per cent. less nitrogen-free extract than average oats. If wholly made from clean oats the digestibility should not be less than that of oats. [For ash analysis see pages 117 and 118.]

Barley Feed.

CCXXXI. A by-product in the manufacture of Pearl Barley. Sampled and sent by B. F. Case, Canton Center.

	Oat Feed. CCXVII.	Barley Feed. CCXXXI.
Water	8.19	13.20
Ash	4.24	4.25
Albuminoids or Protein	12.64	11.94
Fiber	12.48	7.98
Nitrogen-free Extract	56.31	59.38
Crude Fat	6.14	3.25
	100.00	100.00

The Buckhorn Fern. [*Osmunda regalis*, L.]

CCXVI. This sample (2 pounds) was sent by L. J. Platts, Esq., Deep River, who says in regard to it, "It is known here as the buckhorn or broad leaf brake. Of all products of swamp land cattle will eat this with the greatest relish when cured as hay, picking out every leaf before eating much of the bog hay. It is probably the only fern they eat much of. Sheep will eat most varieties to some extent. It grows to a considerable extent in most swamps mixed with bog and other grasses." This sample was cut about the middle of August, and consisted entirely of sterile fronds.

As far as chemical analysis can indicate, the fern is equal to good meadow hay in composition, but it should be remembered that chemical analysis alone does not positively determine the feeding value.

	Fern. (Osmunda regalis.)
Water	14.56
* Ash	6.09
Albuminoids or Protein	10.24
Fiber	21.60
Nitrogen-free Extract	45.10
Crude Fat	2.41
	100.00

* For analysis of the ash, see pages 117 and 118.

Wheat Bran.

CCXXXVIII. Sent by Joshua Lyon, Greenwich. Cost $17.00 per ton by the car load. Bought of Young, Tripp & Co., White Plains, N. Y.

Cotton Seed Meal.

CCXXIII. Sent by E. F. Thompson, Warehouse Point.

Gluten Meal.

CCXXIV. Bought by the Station from Betts & Alling, New Haven, for feeding experiments. Cost, $1.25 per 100 pounds.

ANALYSES.

	CCXXXVIII. Wheat Bran.	CCXXIII. Cotton Seed Meal.	CCXXIV. Gluten Meal.
Water	12.48	7.95	12.29
Ash	6.60	6.96	.66
Albuminoids or Protein	15.06	44.00	29.47
Crude Fiber	8.48	4.10	.97
Nitrogen-free Extract	53.20	21.93	50.62
Crude Fat	4.18	15.06	5.99
	100.00	100.00	100.00

HAY.

CCXXX. Oat Hay sent by B. F. Case, Canton Center.

CCXXXIX. Hay from North Haven. Clear Timothy and Red Top, apparently in about equal proportions. Cut in bloom.

CCXXV. Baled hay. Bought by the Station in New Haven as "*Extra Timothy*" at $22.00 per ton. Sample drawn from a lot of 600 pounds which had been cut in two inch lengths. It was a mixture of all kinds of hay containing clover, timothy, red top, blackberry bushes and some coarser bushes, and considerable dirt, which in one case was noticed to be near the middle of the bale while generally the bales were "faced" with clean timothy.

ANALYSES.

	Oat Hay. CCXXX.	Timothy and Red Top. CCXXXIX.	Baled Hay. CCXXV.
Water	13.78	18.90	15.95
Ash	6.31	4.11	3.93
Albuminoids	7.99	4.97	6.20
Fiber	33.62	25.41	26.60
Nitrogen-free extract	36.23	44.22	45.13
Crude Fat	2.07	2.39	2.19
	100.00	100.00	100.00

ANALYSIS OF FLORIDA ORANGES.

A considerable number of Connecticut citizens are int in orange growing in Florida and from time to time i have been made as to the requirements of that crop whic not be satisfactorily answered from the data at hand.

The subjoined analysis of a fine sample of orange fru ered in its best condition about the first of January and fu by Mr. T. W. T. Curtis of New Haven from his grove in I has been made in order to ascertain what is carried off t in the orange crop. The analysis includes the whole fru comes into market.

Water (with some volatile oil) expelled at 212°	8
Organic and volatile matter (lost at low red heat)*	1
Ash (reckoned free from carbon and carbonic acid)	
	10

* Containing nitrogen .14.

The ash analysis is as follows: For comparison is g analysis of the ash of oranges from "St. Michaels I (Wolff's Aschen-Analysen, 1871, p. 124.)

The ash contains—

	Florida.	St. Michae
Potash	56.44	38.
Soda	1.81	7.
Lime	18.70	22.
Magnesia	4.72	6.
Oxide of iron	.50	.
Phosphoric acid	13.28	14.
Sulphuric "	4.15	2.
Silica	.40	5.
	100.00	100.

The oranges in a single box exclusive of the case and weighed 64.5 pounds. The yield per acre was 100 boxes pounds of fruit. The export per acre in this crop is acco as follows:

Nitrogen	9.2	pounds.
Potash	16.0	"
Soda	0.5	"
Lime	5.3	"
Magnesia	1.4	"
Oxide of iron	0.1	"
Phosphoric acid	3.8	"
Sulphuric acid	1.2	"
Silica	0.1	"

The oranges were quite uniform in size and weight. The total number in the box was 112, and their average weight was 9¼ ounces.

ANALYSIS OF ASPARAGUS.

Nine bunches of asparagus bought in New Haven market weighed 7 pounds 6 ounces. The asparagus contained .37 per cent. of nitrogen. (58.1 per cent. of the nitrogen present was albuminoid-nitrogen and 18 per cent. of it amide-nitrogen.) The composition of the ash is given in the following tables on pages 117 and 118:

A ton of asparagus would take from the land about

6	pounds of	potash.
2.6	"	phosphoric acid.
7.4	"	nitrogen.

ASH ANALYSES OF FEEDING STUFFS.

The following analyses have been made at this Station* by Mr.

---

* The method of ash analysis followed by Mr. Winton is as follows: A known weight of the substance to be analyzed is burned, at as low a heat as possible—in no case as high as a red heat—in a platinum dish over a suitable burner. The burning may require from one to several days' time. During this time it should not be stirred, but near the close of burning the thin layer of char on the surface may be stirred in and the heat continued a little longer. The ash is then thoroughly mixed and pulverized in the dish, weighed and bottled.

Ten grams of the ash are digested on the water bath with dilute hydrochloric acid [one volume of pure concentrated acid with one of water], for one to two hours and the insoluble residue of sand, silica and charcoal is collected on a weighed filter, dried at 100° C. and weighed. The filter paper and charcoal are burned off in a platinum crucible and the sand and silica are weighed together. The difference between this weight and the last represents the charcoal. Sand is separated from silica by boiling repeatedly with a solution of pure sodium hydrate as strong as can be filtered without injuring the paper. When the filtrate no longer contains silica the residue, consisting of sand, and filter is washed with dilute hydrochloric acid and water, ignited and weighed. From the filtrate which contains the soluble portion of the ash, silica is separated and determined in the usual way and added to that already found as above. The solution of the ash, free from silica, is then made up to 1000 c.c. In one portion of 100 c.c. bases are determined as follows:

The solution, nearly neutralized with ammonium hydrate, is heated to about but not above 50° C. 3 c.c. of acetic acid and ammonium acetate in sufficient quantity are added and the solution is vigorously stirred. When the precipitate of iron phosphate has settled it is filtered, washed with water containing a little ammonium acetate, ignited and weighed. In one precipitate thus obtained, phos-

Winton to determine the manurial value of certain foods, at the request of persons who were using them. The figures given denote pounds per 100 pounds of the feed.

The percentage composition of the ash itself is as follows:

phoric acid is determined with ammonium molybdate and in a duplicate. iron is estimated with potassium permanganate after solution and reduction with sulphuretted hydrogen. The sum of the iron-oxide and phosphoric acid is generally a little less than the weight of the first precipitate. The difference, if not within the limits of analytical error is due to silica which escaped separation, or to a trace of alumina. Lime is determined in the filtrate from the iron phosphate by precipitation as calcium oxalate which is ignited and weighed as calcium oxide. In the filtrate from the lime, phosphoric acid is usually present in more than sufficient quantity to combine with all the magnesia. This latter is therefore precipitated by adding ammonium hydrate to slight alkaline reaction. After vigorous stirring and standing for half an hour, ammonium hydrate is added in sufficient quantity to make up one-fourth of the final volume. After standing from four to six hours the precipitate is collected and treated as usual for determining magnesia. Most of the free ammonia is evaporated from the filtrate, magnesia mixture is added, and the remaining phosphoric acid is determined. The total phosphoric acid will be the sum of that which was in the iron phosphate precipitate, that which was obtained in determining magnesia, and that precipitated last with magnesia mixture. If phosphoric acid is not present in excess over magnesia, it can be determined in the precipitate obtained with barium hydrate in the determination of the alkalies. From a second portion of the original solution, after removing nearly all of the free acid by evaporation, sulphuric acid is separated as barium sulphate. The alkalies are determined in the same solution after removing the other bases by barium hydrate and ammonium carbonate. If much magnesia is present this separation must be repeated after removing the ammonia-salts by ignition. After weighing the alkalies as chlorides, potassium is thrown down as potassium-platinum chloride. Chlorine is determined gravimetrically in the nitric acid solution of a portion of the ash. Carbonic acid is estimated with the apparatus devised by Wells and described in the last American edition of Fresenius' Quant. Analysis, 1882, page 415.

WATER, NITROGEN AND ASH-INGREDIENTS IN 1000 POUNDS OF

	Water.	Nitrogen.	Ash.	Potash.	Soda.	Lime.	Magnesia.	Oxide of Iron	Phosphoric Acid.	Sulphuric Acid.	Chlorine.	Sand and Silica.
Winter Wheat Middlings CXCV	127.3	28.2	36.3	10.02	.64	.33	4.27	....	20.48	.90	....	.49
Wheat Middlings CCXXXVI	133.3	25.4	40.3	12.19	.32	.96	5.84	.17	19.70	.26	....	.84
Winter Wheat Bran CXCVIII	133.5	26.4	57.1	16.23	1.36	.25	5.74	....	32.66	.72	....	.18
Wheat Bran CCXXXII	136.0	24.8	42.2	12 33	.62	.79	6.58	.15	20.78	.34	.07	.54
Rye Bran CCXXXIV	122.3	25.3	32.2	10.20	.13	.86	4.21	.05	15.78	.20	....	.74
Corn Meal CCXXXIII	140.7	13.2	13.2	3.86	14	.07	1.91	.11	6.22	.21	.01	.64
Oat Feed CCXXXV	97.6	22.5	36.6	6.60	.23	1.10	2.96	.22	11.07	.68	.04	13.74*
Hay CCXI	120.1	9.8	38.3	13.13	29	5.57	2.61	1.55	2.98	1.23	.30	10.64
Buckhorn Fern [*Osmunda regalis*]	145.6	16.4	58.6	13.68	.69	5.05	4.45	....	1.46	3.32	3.18	27.42
Asparagus	929.7	3.7	5.9	3.02	.07	.26	.23	.06	1.31	.47	.52	.07
Florida Oranges	852.9†	1.4	4.4	2.49	.08	.82	.21	.02	.58	.18	....	.02

* 12.67 of soluble silica.

† Including some volatile oil.

PERCENTAGE COMPOSITION OF ASH.

	Wheat Middlings. CXCV.	Wheat Middlings. CCXXXVI.	Wheat Bran. CXCVIII.	Wheat Bran. CCXXXII.	Rye Bran. CCXXXIV.	Corn Meal. CCXXXIII.	Oat Feed. CCXXXV.	Hay. CCXI.	Buckhorn Fern, [Osmunda regalis.]	Asparagus.	Florida Oranges.
Potash	27.39	30.20	27.98	29.32	31.33	29.29	17.89	34.41	23.31	51.37	56.44
Soda	1.81	.72	3.67	.61	.42	1.06	.64	.77	1.21	1.16	1.81
Lime	.95	2.34	.16	1 88	2.68	.53	3.01	14.54	8.60	4.32	18.70
Magnesia	12.18	14.76	10.04	15.68	13.18	14.53	8.07	6.81	7.58	3.90	4.72
Oxide of Iron	trace.	.44	trace	.34	.16	.86	.62	4.04	trace	1.02	.50
Phosphoric Acid	55.98	48.81	56.42	49.98	49.28	47.14	29.89	7.78	2.64	22.17	13.28
Sulphuric Acid	.27	.65	1.26	.80	.62	1.64	1.85	3.22	5.65	8.04	4.15
Chlorine	----	trace	----	.11	trace	.07	.12	.79	5.42	8.75	----
Sand and Silica	1.42	2.08	.47	1.28	2 33	4.88	37.91	27.80	46.74	1.23	.40
	100 00	100.00	100.00	100.00	100.00	100.00	100.00	100.16	101.15	101.96	100.00
Deduct Oxygen Equivalent to Chlorine								.16	1.15	1.96	
								100.00	100.00	100.00	

MILK ANALYSES.*

The following analyses† have been made of the milk of selected cows in the herd of Hon. T. S. Gold, of West Cornwall. When the samples were taken, in June and in October, the cows were on pasture, and had no other feed. During the day they had a range of seventy-five acres, and at night of some five acres. They were driven night and morning about fifty rods to and from pasture. The samples were taken by Mr. Farrington, of the Station, immediately after the milking which was done in his presence, and he also weighed the milk on scales provided by the Station. The time of milking was 6 P. M. and 5 A. M. All the figures given are the average of duplicate determinations which in general agreed very closely. Rejecting the milk of the two Holsteins, Keiser 3d, and Sneeker 4th, the results may be briefly summarized as follows:

	Milk of Individual Cows.		Mixed milk of the herd as sent to market.			
			June.		October.	
	June.	October.	Night.	Morning.	Night.	Morning.
Average Solids	13.30	13.62	13.23	13.05	13.84	13.31
Maximum "	14.53	14.94				
Minimum "	11.95	12.38				
Average Fat	4.11	4.56	4.15	3.91	4.61	4.01
Maximum "	5.04	5.51				
Minimum "	3.42	3.50				

In a single case the total solids were less than 12.0 per cent. The mixed milk of the herd is of excellent quality.

Ewkahn, a full blood Ayrshire 4 years old, calved on Oct. 4th. On the evening of the 6th and morning of the 7th of Oct. her milk, or more properly, colostrum, had the following composition:

	Evening.	Morning.
Solids	16.32	15.04
Fat	6.03	4.61
Casein [Nitrogen × 6.25]	4.37	4.63

The difference between the first milk drawn and the strippings is seen from the following tests made in June on the milk of Brindle, a grade Ayrshire, 10 years old, who calved in March.

	Evening		Morning	
	First quart milked.	Last quart milked.	First Milk. About ½ pint from a single teat.	Strippings.
Solids	10.82	17.24	9.86	16.38
Fat	1.22	8.48	.61	7.63
Casein [Nitrogen × 6.25]	3.88	3.69	3.69	3.38

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* See note on page 139.

† See pages 120–123.

T. S. GOLD'S HERD—TESTS MADE JUNE 11TH AND 12TH, 1886.

Breed	Names.	Age. Years.	When calved.	Time of milking.‖	Weight of milk.	Solids.	Fat.	Casein. [Nitrogen, × 6.25]
Holstein	Keiser 3d, No. 4696. H. Herd Book	3	March.	N.	13 lbs.–7 oz.	11.40	2.89	3.50
Holstein	Truie,‡ No. 5749. "	3	March.	N.	14–15½	13.32	3.78	4.00
Holstein	Sneeker 4th, No. 4695. "	3	March	N.	13–0	11.30	3.56	2.88
Holstein	Sneeker 4th, No. 4695. "	3	March.	M.	12–2	10.42	1.48	2.86
Ayrshire†	Bessie	9	April.	N.	16–8	12.55	3.60	
Ayrshire†	Short-legged Ayrshire	4	April.	N.	11–13½	12.71	3.47	3.63
Ayrshire†	Short-legged Ayrshire	4	April.	M.	11–15	13.04	3.64	3.58
Ayrshire†	Belle of Cream Hill	14	Dec.	N.	10–4½	12.92	3.48	4.32
Grade Ayrshire	Black	8–9	----	N.	10–11	12.81	4.01	
" "	Lillie	6	Jan.	N.	10–8	13.56	3.97	
" "	Cherry	10	April.	N.	13–12	12.53	3.85	3.19
" "	Pride of America	8	April.	N.	17–0	13.88	5.04	3.50
" "		3	10 days ago‡	N.	15–12	13.78	4.21	4.29
" "	Louisa	6	Feb.	N.	13–1	12.87	3.82	3.87
" "	Bobtail	6	Sept. 1885.*	N.	8–15½	14.57	4.79	2.76
" "	Rubber teat	10	March.	N.	18–1	13.53	4.48	3.38
" "	Rubber teat	10	March.	M.	17–2	13.53	4.52	3.72

* Due in September, 1886. † Full blood, but not registered. ‡ First calf. ‖ N., night; M., morning.

T. S. GOLD'S HERD—TESTS MADE JUNE 11TH AND 12TH, 1886.

Breed.	Names.	Age. Years.	When calved.	Time of milking.|	Weight of milk.	Solids.	Fat.	Casein. [Nitrogen × 6.25.]
Grade Ayrshire	Bug Horn	10	February.	N.	14 lbs.–5 oz.	12.44	3.47	3.25
" "	Excelsior	10	March.	N.	17–5	13.07	4.18	3.61
" "	Excelsior	10	March.	M.	15–1	13.39	4 55	3.38
" "	Curly Head	5	March.	N.	15–14	13.11	4.13	3.91
" "	Mattie	4	Sept. 1885.*	N.	6–13	13.91	4.36	4.28
" "	Dolly Varden	12	May.	N.	18–11½	12.70	4.62	3.88
" "	Dolly Varden	12	May.	M.	12–1	11.95	3.42	3.75
" "	Josie	4	Aug. 1885.	N.	7–8	14.37	4.37	4.69
" "	Beauty	9	February.	N.	8–6	13.63	4.21	3.72
" "	Three teat	7	April, 1885.	N.	6–0	14.52	4.85	3.81
" "	Three teat	7	April, 1885.	M.	5–5	14.49	4.51	4.13
" "	Brindle	10	March.	M.	13–13½	12.64	3.47	3.57
	Sample of the mixed night's milk of the whole herd (40 cows), taken from six 40-quart cans					13.23	4.15	3.68
	Sample of mixed morning's milk of whole herd (40 cows), taken from five 40-quart cans					13.05	3.91	3.81

* Due in September, 1886.

| N., night; M., morning.

T. S. GOLD'S HERD—TESTS MADE OCTOBER 7TH AND 8TH, 1886.

Breed.	Name.	Age. Years.	When calved.	Time of milking.†	Weight of milk.	Solids.	Fat.	Casein. [Nitrogen × 6.25.]
Holstein	Keiser 3d, No. 4696	3	March.	N.	8 lbs.–4 oz.	11.18	3.28	2.97
"	" 3d, No. 4696	3	"	M.	8–4	10.64	1.37	2.84
"	Truie, No. 5749	3	"	N.	6–7	14.53	5.12	3.56
"	" No. 5749	3	"	M.	8–8	14.03	4.71	3 69
"	Sneeker 4th, No. 4695	3	"	N.	6–6½	11.62	3.57	3.15
"	" 4th, No. 4695	3	"	M.	8–1	10.97	2.88	3.00
Ayrshire*	Bessie	9	April.	N.	8–4	13.88	4 97	3.44
Ayrshire*	Short legged Ayrshire	4	"	N	6–10	13.60	4.44	3.28
Ayrshire*	Belle of Cream Hill	14	December.	N.	6–12	14.33	4.85	3 75
Grade Ayrshire	Black	8–9	May.	N.	6–4	13.47	4 59	3.47
" "	Cherry	10	April.	N.	9–9	12.48	3.99	3.06
" "	Rubber teat	10	March.	N.	8–11	13.87	5.28	3.37
" "	" "	10	"	M.	10–11	12.86	3.93	3.47
" "	Excelsior	10	"	N.	7–3	14.44	5.08	3.50
" "	"	10	"	M.	10–11	13.18	4.05	3.32
" "	Curly Head	5	"	N.	7–11	14.12	4.51	3.44

* Full blood but not registered.

† N. night; M. morning.

T. S. GOLD'S HERD—TESTS MADE OCTOBER 7TH AND 8TH, 1886—*Continued.*

Breed.	Name.	Age. Years.	When calved.	Time of milking.†	Weight of milk.	Solids.	Fat.	Casein. [Nitrogen × 6.25.]
Grade Aryshire	Mattie	4	September.	N.	4lbs.-14oz.‡	13.19	4.18	3.37
" "	Dolly Varden	12	May.	N.	9–11	12.90	4.56	3.25
" "	"	12	"	M.	11–10	12.38	3.75	3.34
" "	Beauty	9	February.	N.	7–1	14.94	5.51	3.72
" "	"	9	"	M.	8–8	13.64	4.15	3 56
" "	Brindle	10	March.	N.	9–0	13.36	4.00	3 53
" "	"	10	"	M.	10–8	12.82	3.50	3.41
Ayrshire*	Ewkahn	4	October 4.	N.	9–1	16.32	6.03	4.37
"	"	4	October 4.	M.	13–0	15.03	4.61	4 63
Grade Ayrshire	Amy	2	3 wks. ago.	N.	8–5	14.08	4.87	3.31
" "	Strawberry	8	May.	N.	9–0	13 63	4 64	3.41
" "	"	8	"	M.	10–8	14.02	4.60	3.53
	Sample of mixed night's milk of whole herd (40 cows)	--	----	--	----	13.84	4.61	
	Sample of mixed morning's milk of whole herd (40 cows)	--	----	--	----	13.31	4.01	

* Full blood but not registered.

† N. night; M. morning.

‡ Nearly dry.

A similar trial in October gave:

	First of Milking.	Strippings.
Solids	11.08	16.27
Fat	1.79	7.55
Casein [Nitrogen × 6.25]	3.53	3.37

It will be noticed that the solids and fat in the milk of one of the Holsteins, Truie, were slightly below the average of the herd in June and considerably above the same average in October, while the solids and fat in the milk of the other Holsteins, Keiser 3d, and Sneeker 4th, who calved about the same time as Truie and whose total milk-yield was not very different, were below the average of the herd both in June and October.

The result merely shows that at these particular times two of the Holsteins were giving milk which, judged by its analysis, was of poor quality. It does not prove that either of these cows is generally a thin milker.

Samples of the milk of Keiser 3d, taken Dec. 27, were of better quality. The total weight of the night's milk was 4 lbs. and 7 oz. The morning milk weighed 8 lbs. and 5 oz. The composition of the milk was as follows:

	Keiser 3d, Morning.	December 27, Night.
Total Solids	11.81*	13.11
Fat	3.19	4.06
Casein, [Nitrogen × 6.25]	3.38	3.56
Sugar	4.03	4.61
Ash	.70	.72
Specific Gravity	1.031	

The feed of the cows at this time was good hay twice a day as much as they would eat or fodder corn [rather poor] and four quarts of mixed feed (new process linseed meal and wheat middlings), and one peck of mangolds.

The variations which may be found at any given time in the quality of milk of single cows of the same breed have been illustrated in previous reports. Thus the average composition of the milk of 10 Ayrshires in the herd of S. M. Wells, Esq., of Wethersfield was:

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* It will be noticed that the sum of the fat, casein, sugar and ash obtained by direct determination is less than the total solids, directly determined, in one case by .51, in the other by .16 per cent. If the factor 6.4 is used in reckoning casein from the nitrogen, which is unquestionably more correct, the differences will then be .43 and .07 per cent.

Solids	12.55 per cent.
Fat	3.91 "

But the milk of one of the cows had only 11.27 per cent. of solids, while that of another had 12.77, a difference of 1.5 per cent. The fat varied between 3.17 and 4.30 per cent.

The average composition of the milk of 7 Guernseys in the herd of E. Norton, Esq., of Farmington, was:

Solids	14.93
Fat	5.34

But the solids in the milk of individual cows varied by 4.3 per cent., from 12.81 to 17.15 per cent., and the fat from 4.0 to 6.17 per cent.

Other facts which go to explain the quality of the Holstein milk in this case are stated by Mr. Gold as follows:—

"While the Holsteins are larger they are less combative than the Ayrshires. As the Ayrshires were all raised on the farm they naturally herd together and after two years the three Holsteins rather keep by themselves when they can, and are in the position of underlings or strangers in the herd, which condition is not favorable to the best or highest milk production. My experience formerly in bringing in a few strange cows has led me to expect this difficulty. I am now raising Holstein grades. In them the Ayrshires will find their match and will learn to tolerate and respect black and spotted cattle."

Similar facts have been brought to the notice of the Station before, and it is well established that any kind of worry has a very marked influence on the quality of milk. The improved milk of Keiser 3d, on stall feeding is perhaps partly due to her greater freedom from persecution by the other cows.

NOTES ON MILK-ANALYSIS.*

Determination of Total Solids.—The method employed at this Station is to bring 5 grams of the milk into a small porcelain capsule of 1½ inch diameter, containing a small stirring rod and 15–20 grams of perfectly dry pulverized quartz ("glass sand"). The total weight of the capsule, rod and sand are previously determined. Our capsules and rods are of such weight that in every case we add sand till the total weight is exactly 40 grams.

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* The experiments under this head have been carried out by Mr. Farrington of this Station.

After the milk has been weighed in, the capsules are placed over a water bath and the contents are frequently stirred till the sand and milk set and cannot be longer stirred without danger of mechanical loss. After standing from 1–1½ hours on the bath, they are placed for an hour in a drying oven which has a temperature a little below 100° C. They are then cooled and weighed and again dried until the weight is practically constant, i. e. till the loss after an hour's drying is not more than five hundreths of one per cent.

Duplicate analyses show very close agreement and the method has been most carefully compared by Schmœger* with the result obtained by drying in hydrogen, which latter method must be regarded as theoretically more nearly perfect than any other. The results by these two methods agreed within about one tenth per cent., being slightly higher by the sand method.

The English Society of Public Analysts in March of the present year agreed on the following method: "Total Solids. These to be estimated by evaporating in a platinum dish about 5 grams of milk. The residue to be dried to practical constancy at the temperature of a water oven or water bath."

The Association of Public Analysts of New York have adopted essentially the same process (only finishing the drying at 105° C.) and it is commonly referred to as "Waller's method," being a modification of the method originally proposed, we believe, by Wanklyn.

The following trials have been made to compare our present method with the method above described of the English Analysts' Association. The form of dish is not stated and would perhaps have an effect on the results. The platinum dishes used here were flat bottomed, two inches square and five-eighths of an inch deep. Five grams of milk were used in each trial.

TOTAL SOLIDS.

No. of sample.	I.†	II.	III.	IV.	V.	VI.	VII.	VIII.
Station method	23.87	14.73	13.30	12.66	12.47	12.21	12.20	11.85
	23.86	14.54		12.68			12.23	11.89
Analysts' method	23.77	14.69	13.36	12.73	12.65	12.33	12.25	11.86
		14.70					12.23	

	IX.	X.	XI.	XII.	XIII.
Station method	9.26	11.99	10.00	8.35	7.69
	9.29	11.94	9.98		
		11.99			
		11.98			
Analysts' method	9.29	12.01	10.02	8.35	7.71
		12.01	10.03		

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* Pflüger's Archiv., xxxi, 1883.

† Cream.

The following results were on a sample which had been kept two weeks in the laboratory previous to analysis. It was coagulated and very sour but not putrid. The weighing was made in a small covered beaker and the clotted milk was stirred immediately before each portion was poured out.

TOTAL SOLIDS.

	Station Method.	Analysts' Method.
No. 1	12.21	
No. 2	12.06	
No. 3		12.09
No. 4		12.03
No. 5	11.94	
Average	12.07	12.06

The comparisons show that the results by the two methods agree within the limits of experimental error. The English Analysts' method is the more convenient when it is simply desired to learn the amounts of water and total solids. The sand-method is better when an accurate fat determination is subsequently to be made.

Determination of Fat.

It has been proposed to determine fat indirectly by exhausting with ether or benzine the Total Solids as obtained by the English Analysts' method, and weighing the residue remaining from this treatment.

In the trials of this plan made here a light (petroleum) benzine, furnished by the Maverick Oil Co., of Boston, was used, which left no residue on evaporation. The dish with the Total Solids was half filled with benzine, heated to boiling in the oven and decanted off. This treatment was repeated six times and then the dish and contents were thoroughly dried and weighed.

The method usually employed at this Station is to remove the sand and dry residue from the capsule used in the Total Solids determination, pulverize it finely, bring it into a continuous extractor and wash with hot absolute ether for at least three hours, we prefer four or five hours. The ether extract is received in a weighed flask, the ether is distilled off and the fat dried in the steam oven to a constant weight. Following are the results of comparative determinations made by the two methods.

FAT DETERMINATIONS.

	Station Method.	Indirect Method.	Difference.
Duplicates	4.34	4.08	.26
	4 36	4.12	.24
	4.21	3.59	.66
	4.14	3.89	.25
	3.85	3.20	.65
Duplicates	3.17	3.14	.03
	3.21	3.02	.19
	2.84	2.30	.54
	2.62	2.44	.18

A sample of milk which, by the Station method of extraction above described, in four trials gave 3.01, 3.02, 3.04 and 3.05 per cent. of fat, by successive treatment with benzine yielded the following quantities:

	Per cent. of Fat.	
Digested five times with benzine	2.67	2.67
Digested seven times with benzine	2.74	2.75
Digested nine times with benzine	2.80	2.79
Digested twelve times with benzine	2.86	2.82

That is, about .2 per cent. less fat were obtained after twelve successive treatments with benzine than were obtained by the Station method.

The above figures prove that the method used at this Station yields more accordant results in duplicate work and in general gives a notably greater percentage of fat than this indirect method.

With suitable apparatus* for continuous extraction the method here employed is not less convenient than the other.

A possible error in the determination of fat lies in the use of extracting apparatus whose parts are connected by corks, due to the waxy matters of common cork which are slowly dissolved by ether and other fat-solvents.

To ascertain the extent of the error thus incurred an apparatus made entirely of glass, with ground joints, has been provided. In two portions of milk, fat was determined by extracting the residue dried with sand in this apparatus by means of ether for four hours. Fat was also extracted from two other portions of the same milk in the apparatus commonly employed here fitted with corks which had been some time in use. The results are as follows:—

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* The apparatus employed is essentially that first described and figured by S. W. Johnson in American Journal of Science, June, 1877. The same arrangement was afterward described by Tollens.

Fat extracted in apparatus with glass joints	3.04	3.05
Fat extracted in apparatus with cork joints	3.01	3.02

Other blank trials were made in apparatus provided with old and new corks, and the matter extracted was weighed with extreme care in small flasks, each of which was counterpoised by a similar empty flask so as to avoid error due to unequal condensation of moisture on the glass. The apparatus A had been in use for perhaps a year without change of corks. B had one cork long in use and one new one, C had two new corks which had never been treated with ether. Following are the times of extraction and the weights of matter extracted:

	A	B	C
9 hours.	nothing.	.0011	nothing.
19 "	.0003	.0025	.002
29 "	.0010	.0037	.003
39 "	.0020	.0040	.0033

By extraction for double the time which is necessary for a fat determination in milk, nothing appreciable is taken from the corks and extraction for 39 hours removed in the extreme case 4 milligrams which would make an error of only .08 per cent. in a milk analysis.

We therefore conclude that narrow corks as used in the station apparatus are without effect on the accuracy of the fat-estimations.

The English Society of Public Analysts have adopted the following method of determining fat in milk, sometimes called, from the name of the originator, " Adams' method."

"Pipette 5 c. c. of milk into a beaker 2 inches deep by 1½ inch in diameter; weigh and place into it one of Mr. Adams' coils, viz: rolled-up strip of white demy blotting paper (sharply cut to 2½ inches wide and 22 inches long), which must have been previously extracted with ether in a Soxhlet apparatus, and the ether driven off. When as much as possible of the milk has been taken up by the paper, the coil is removed and placed dry end downwards upon a slip of glass, and the beaker (which should be kept covered by a bell-jar during the absorption of the milk) is at once re-weighed. Dry the coil in a water oven for a period of one to two hours, and extract the fat by ether in a " Soxhlet " apparatus, twelve syphonings at least being necessary; the flask in which the solution is collected being as small and light as possible. Boil off the ether, and place the flask in a water oven, in a horizontal position, and dry to constancy; allow to cool for about ten minutes, and weigh." (The Analyst, vol. x, p. 217, and vol. xi, p. 66).

It was proposed by Adams,* also to determine total solids by this method using coils which had been previously dried and weighed in closed tubes.

The following experiments have been made to test the method. The coils were of the common white demy blotting paper which is considerably heavier than the English paper. A strip 11 inches long and 2½ inches wide is as heavy and presumably as effective for this purpose as a strip of the English paper of the size recommended by the Analysts' Association. Nine of the coils were first extracted for an hour with ether and then dried for six hours in tubes which could be closed with ground glass stoppers. They were then extracted with ether for four hours and the extract was dried in the water oven for three hours and weighed. The extraction was repeated for the same length of time. By the first four hours extraction the average weight of matter extracted from each coil was .0027 grams. The second extraction removed on the average .0007 grams from each coil. The coils were now charged with milk in the manner directed and dried in the water bath. They were weighed at the end of three hours, and again at the end of six hours. After three hours they were still far from dry. After six hours the average dry matter was 11.52 per cent.; maximum 11.78, minimum 11.30.

In the same milk the sand method gave 11.98 per cent. and the English Analysts' method 12.01 per cent. The experiment was not continued further as it was evident that the results were worthless.

The coils were then extracted with absolute ether for five hours in the apparatus commonly used here, as above described, and the fat extract was dried to constant weight.

For comparison the coils were also dried and thus the fat was indirectly determined by the loss of weight of the coil. In the following table are given the results:

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* Analyst, vol. x, p. 50.

ADAMS' METHOD.

No. of sample.	Fat reckoned from loss of weight of coils.	Fat reckoned from weight of fat.	Station method.
X	3.10	3.06	3.05
X	3.07	3.09	3.04
X	3.14	3.08	3.02
X	2.86	3.03	3.01
X	3.07	3.01	
X	3.06	3.01	
X	3.05	3.02	
X	3.13	3.02	
X	lost	3.03	
Average	**3.06**	**3.04**	**3.03**
XI	1.07	1.00	.91
XI	1.02	.99	.90
XII	1.53	1.38	1.41
XIII	.90	.75	.71

It appears that any results depending on the weight of the dried coils are unreliable as might be expected considering the hygroscopic nature of paper and the fact that it is so easily oxidized. The results obtained by weighing the fat extracted from the coil have shown very satisfactory agreement in all cases with the results of the sand extraction.

If the coils after absorption of milk are thoroughly dried as is necessary to prevent extraction of any other bodies than fat, there seems to be no saving of time over the sand method, unless possibly in cases where a determination of fat without total solids is desired. The use of asbestus in a tube to absorb milk for the determination of solids and fat has been proposed by Dr. Babcock of the New York Station. A bibulous asbestus paper made of the finely shredded material might prove to be a perfect substitute for paper and admit of accurate determination of solids, fat and possibly ash in a single portion of the milk.

EXAMINATION OF BUTTER.

The General Assembly at its last session passed an act entitled, An Act to Prevent and Punish Fraud, which places certain restrictions on the sale of imitation butter, appoints a Dairy Commissioner whose duty it is to prosecute for violations of the law and provides in the 5th section that "The Dairy Commissioner may have samples suspected to be imitation butter analyzed at the Connecticut Agricultural Experiment Station or by any State chemist, and a sworn and affirmed certificate of the analyst shall be *prima facie* evidence of the ingredients and constituents of the sample analyzed."

The Commissioner, Hon. J. B. Tatem, having in May represented to the Director that he must depend solely upon the Experiment Station for the chemical work requisite for identifying "imitation butter," it was decided to undertake the analyses needed, in order that there should be no failure in the enforcement of the law, although evidently the Station was under no legal obligation to assume the work, and notwithstanding, the Commissioner represented that there were no funds at his disposal to sustain the expenses which would be incurred.

This undertaking has involved a considerable outlay of time, both in the examinations made for the Commissioner and in the necessary testing of methods. It was also found advisable that the Director or Vice-Director should be present whenever prosecutions were brought in court. In both Massachusetts and New Jersey the clause providing that the certificate of a chemist shall be *prima facie* evidence, has been declared objectionable by the supreme court, and it is held that the analyst himself must appear in person. The interruption occasioned by this attendance at police courts all over the state has been very serious and the loss of time to the Station has hardly been made good by the mileage and the witness fee of fifty cents allowed by the court.

During the six months since the law went into force, 61 samples have been examined by the Station for the Commissioner, and of these 47 were found to be imitation butter within the meaning of the statute. In no case has there been any serious dispute as to the correctness of the Station certificate. The samples were all received either from the hands of the Commissioner or under his official seal and were designated by numbers, so that the Station had no knowledge of the origin of the samples till the cases were called in court. The results of the examinations follow in detail, and they may be prefaced with some notice of the methods of testing and an account of some experiments bearing on the subject.

The examination of the samples referred to has consisted (1) in the determination of the specific gravity of the filtered butter fat at the temperature of boiling water, and (2) the determination of the volatile fatty acids in the filtered fat by Reichert's method.

Preparation of the Butter Fat.

A suitable quantity of butter—not weighed—is brought into a test tube 1 inch in diameter and 8 or 10 inches long together with a tea spoonful or two of table-salt, and placed in a bath at 100° C. When the butter melts, the contents of the tube are well mixed by shaking, then let stand until the melted fat has separated completely from the brine. The salt shrinks the casein-flocks together and facilitates the separation of the water present. The melted fat is then filtered hot. For this operation we use a circular copper vessel closed above, having a single opening for pouring in water and for the escape of steam. This bath has five funnel-shaped holes, into which glass funnels will fit closely. A lamp beneath keeps the water in the bath boiling. For filtration, Schleicher and Schüll's filter paper is used. The filtered fat is received in tubes used for the determination of specific gravity.

Determination of Specific Gravity of Butter Fat at near 100° *C.*

This is done at the temperature of boiling water by means of Westphal's hydrostatic balance, as first described by Estcourt and by J. Bell in the Chemical News, vols. xxxiv, 254 and xxxviii, 267.

The balance is so adjusted that water at 15.5° shall represent unity. Thus with water at 15° C. the instrument indicated a specific gravity of .999. With distilled water at the temperature of boiling, the instrument indicated a specific gravity of .9625. If the specific gravity of fat at the temperature of boiling water is desired, using the weight of an equal volume of distilled water *at that temperature* as a standard, the reading of the instrument must be multiplied by 1.039.

We have also used an areometer made for us by E. Greiner, 79 Nassau St., N. Y., 6⅜ inches long, which reads from .8550–.8700 and is graduated to show differences of .0005 in sp. gr. The following comparison shows the substantial agreement of the two instruments.

	Specific Gravity at 100° C. by	
	Areometer.	Westphal's Balance.
Canton creamery butter	.8650	.8638
Market butter, No. 5	.8650	.8654
" " No. 6	.8655	.8650
" " No. 7	.8660	.8653
Butterine	.8605	.8607
Oleomargarine	.8580	.8582

But the areometer, in our experience, is not quite so convenient as the Westphal balance, because it requires a somewhat larger volume of fat and a glass vessel for the boiling water.

Determination of the Volatile Fatty Acids.

This is done according to the method proposed by Reichert, (Fres. Zeitschr., xviii, p. 68). 2.5 grams of the clear filtered fat are weighed into a flask of 150 c.c. capacity with one gram of potassium hydrate and 20 c.c. of 80 per cent. alcohol. The mixture is heated on a water bath till the fat is perfectly saponified and all the alcohol has been expelled, 50 c.c. of water are then added and the soap perfectly dissolved, 20 c.c. of dilute sulphuric acid (1 volume of acid in 10 of water) and a few pieces of pumice stone are added and the contents of the flask are distilled. The distillate, after passing a small filter is received in a 50 c.c. tube or flask and the distillation is discontinued when exactly 50 c.c. have come over. This distillate is titrated with $\frac{1}{10}$ normal potassium hydrate solution, using phenol-phthalein as an indicator. The distillate, after titration, was usually tested for sulphuric acid, which might have been carried over by incautious boiling.

We have departed from Reichert's directions in two particulars, having proved by experiment that the change is without influence on the result. He directs to pour back the first few centimeters of the distillate into the distilling flask, apparently to rinse the apparatus but the result is the same whether it is done or not. He also directs to weigh off the *melted* fat. Our practice has been to congeal it in small capsules, weigh capsule and butter and remove 2.5 grams with a platinum spatula or piece of foil which is dropped into the flask with the butter. The only objection to this is that the butter fats might separate somewhat in cooling according to their specific gravities, so that the mass would not be homogeneous. With the spatula however, a core of butter fat is taken out from the surface to the bottom of the dish. To ascertain to what extent separation of butter fats might thus occur, the following experiment was tried.

Into a glass cylinder 1¼ inches in diameter 14½ inches long and closed below was poured melted butter fat which at 100° C. had a sp. gr. of .866. The tube was nearly immersed vertically in a water bath and cooled slowly. The initial temperature was 50.4° C. After one hour it was 47°, after two hours 40°, three hours 34.5°, four hours 32.5°, five hours 31°, etc. Twelve hours afterwards there were places in the tube where the oil appeared to be still liquid. The tube was therefore placed in a refrigerator in a mixture of ice and salt, and after the contents appeared to have perfectly solidified, the tube was slightly heated and the core of butter fat pushed out. A section from the interior portion at the top of the tube was numbered 1, one taken half-way down the tube was numbered 2, one from the bottom was marked 3. An oily portion from the interior of the butter core which had not solidified was marked 4. The specific gravity and volatile fatty acids of these samples were found to be as follows:—

	Specific gravity at 100° C. Water at 15.5° C.=1.	Cubic centimeters of $\frac{1}{10}$ normal potassium hydrate solution equivalent to volatile fatty acids. Duplicates.	Average.
No. 1—Top layer	.8645	14.62–14.70	14.66
No. 2—Middle layer	.8650	15.13–15.73	15.43
No. 3—Bottom layer	.8653	14.88–14.99	14.94
No. 4—Oily portion	.8670	17.30–17.31	17.31

The results of this experiment indicate that no serious error is likely to be encountered by allowing the butter fat to cool in a capsule and taking a portion as we have practiced for determining the volatile fatty acids.

Effect of rapidity of distillation.—It is known that all volatile acid is not removed by Reichert's method and it might happen that the amount obtained in 50 c.c. of distillate would vary with rapidity of distillation. To test this point, three equal weights of butter fat from pure butter were saponified as usual and the soap solutions, decomposed by sulphuric acid, were distilled as above described, with the difference that 50 c.c. of distillate were collected from one portion in 26 minutes, from the second, in 35 minutes, and from the third portion in 60 minutes. The number of cubic centimeters of $\frac{1}{10}$ normal potash solution neutralized were

No. 1	15.1
No. 2	14.8
No. 3	14.6

All distillates were free from sulphuric acid. The temperature in the flasks, it may be noted, rises to 103.5°–104° C. The time of distillation is thus shown to have no important influence on results.

Tests on Pure Butter.—The following determinations of specific gravity and volatile fatty acids in the filtered fat of pure dairy butter, we owe to Prof. J. H. Washburn of the Storrs Agricultural School. They serve to show the limits within which pure butter made in this State may vary in these particulars. The figures in the column headed Volatile Fatty Acids give the number of cubic centimeters of $\frac{1}{10}$ normal potassium hydrate solution required to neutralize the volatile fatty acids in 2.5 grams of the filtered butter fat.

Date when butter was made		Specific gravity at 100° C. Water at 15.5° C.—1.	Volatile fatty acids.
July.	Dairy of Augustus Storrs	.8650	12.9
Aug. 2.	" " "	.8643	12.5
June 1.	" " Storrs School*	.8670	16.3
June 14.	" " "	.8658	14.1
July 22.	Mansfield Creamery, Merrow	.8645	14.6
27.	" "	.8650	14.8
Aug. 2.	" "	.8652	14.8
July 27.	Guernsey butter, farm of C. M. Beach, Hartford	.8660	13.8
Aug. 2.	Guernsey butter, farm of C. M. Beach, Hartford	.8650	14.3
9.	Guernsey butter, farm of C. M. Beach, Hartford	.8658	14.5
July 27.	Jersey butter, farm of C. M. Beach, Hartford	.8644	13.2
Aug. 2.	Jersey butter, farm of C. M. Beach, Hartford	.8651	13.4
9.	Jersey butter, farm of C. M. Beach, Hartford	.8658	14.8
May.	Canton Creamery butter	.8660	15.6
20.	Butter made at Experiment Station (grade Alderney)	.8660	15.3

Prof. Washburn has also begun in coöperation with the Station a systematic examination of the butter of certain dairies to be continued through the year, noting food, etc. The results thus far obtained he reports as follows:—"The feed from which Mansfield Creamery butter was made cannot be definitely stated because so many farmers sell their cream to the corporation. The company allows not over one quart of linseed meal daily, and no cotton seed.

Mr. S. O. Barrows of Mansfield, who owns 'Silver Brook Farm,' has a herd of high grade Jerseys. He feeds 4 quarts corn and cob meal, and what corn stalks and oat straw the cows will eat.

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* Had been salted down. Examined in July.

The Storrs School has 3 registered Jerseys, 1 Guernsey and 5 grade Jerseys. They are fed one bushel of corn-stalks and hay (poor quality), about equal parts, cut together and wet with warm water, 1 quart fine bran, and 1 quart corn ground with the cob. They have the above ration night and morning.

Mr. Augustus Storrs has a herd of full blood short horns. He feeds 4 quarts of meal daily, 1 bushel steamed corn fodder and one feed of English hay of the best quality."

Date when butter was made.		Specific gravity at 100° C. Water at 15.5° C.=1.	Volatile fatty acids.
Oct.	Mansfield Creamery	.8644	14.9—15.1
Nov.	" "	.8646	14.5—14.6
Dec.	" "	.8650	14.7—14.8
Oct.	Storrs Agricultural School	.8653	15 8—15.9
Nov.	" " "	.8655	15.1—15.2
Dec.	" " "	.8652	14.2—14.3
Nov.	S. O. Barrows	.8644	13.2—13.4
Dec.	" "	.8644	14.4—14.6
Dec.	Augustus Storrs	.8648	14.0—14.1

The specific gravity observed in single cases has been as low as .8643 and as high as .867. The average of 24 tests is .8652. Allen found .865. The volatile fatty acids have varied between 12.5 and 16.3. The determination of specific gravity and of volatile fatty acids in any sample will, we believe, detect with absolute certainty the presence of any considerable amount of fat other than butter fat. Either determination by itself is ordinarily satisfactory evidence of the nature of a butter sample. We have however preferred to make assurance doubly sure.

Determinations made at this Station for the Dairy Commissioner.

A sample of pure oleomargarine had a specific gravity of .8582 and yielded volatile acids equal to 1.8 c.c. decinormal alkali.

A sample of "butterine, best quality, guaranteed to contain fifty per cent. of pure butter" and which had excellent flavor, had a specific gravity of .8607 and volatile acids, =4.0 c.c.

Here follow the determinations made at this Station on samples sent by the Dairy Commissioner, and which are of value as showing the quality of the articles now in the market and on which a chemist may be required to pass judgment.

It is seen that all samples whose sp. gr. is but .861 or less are proved not to be butter by their pronounced deficiency of volatile acids, 0.8 to 4.4. On the other hand, all the samples with volatile acid=12.5 or more have a sp. gr. of .864 or over.

No.	Specific gravity at near 100° C. Water at 15.5=1.	Volatile fatty acids.
1	.8610	1.0
2A	.8650	15.3
2B	.8655	13.6
3	.8609	4.4
4A	.8598	2.1
4B	.8598	2.0
5	.8650	14.8
6	.8653	15.5
7	.8658	15.9
8	.8601	1.6
9	.8649	16.3
10	.8655	15.7
11	.8601	1.6
12	.8600	1.8
13A	.8593	2.4
13B	.8580	2.5
14	.8590	1.9
15	.8650	15.1
16	.8590	1.6
17A	.8597	2.1
17B	.8609	1.8
18	.8592	1.5
19	.8600	1.5
20	.8585	2.5
21	.8640	13.4
22	.8603	1.4
23	.8600	1.3
24	.8600	2.4
25	.8665	15.0
26A	.8650	14.6
26B	.8580	1.7
27	.8606	1.9
31*	.8608	0.9
32	.8610	1.0
33	.8610	1.0
34	.8589	1.2
35	.8601	1.8
36	.8607	0.8
37	.8591	1.4
38	.8600	1.2
39	.8605	1.9

* Three numbers were not sent to the Station.

No.	Specific gravity. Water at 15.5—1.	Volatile fatty acids.
40	.8600	1.6
41	.8590	1.9
42	.8604	2.3
43	.8600	1.4
44	.8600	2.2
45A	.8595	2.9
45B	.8595	1.9
46	.8655	14.8
47A	.8600	1.9
47B	....	12.9
48	.8595	1.8
49	.8593	1.4
50	.8598	2.0
51	.8606	1.3
52	.8595	2.1
53	.8650	13.4
54	.8585	1.0
55	.8597	3.5
56	.8600	1.3
57	.8593	1.9

It will be seen that there was no room for question as to the character of the sample in any case. With the exception of Nos. 2A, 2B, 5, 6, 7, 9, 10, 15, 21, 25, 26A, 46, 47B and 53, all the samples were declared to be "not made wholly, salt and coloring excepted, from the milk of cows," and hence were "imitation butter" within the meaning of the statute. The Commissioner has brought thirty-nine suits in consequence and secured conviction in every instance, no attempt having been made to invalidate the verdict of the Station tests.

NOTE.—In reference to the milk analyses which are given on pages 119–125, Mr. Gold writes:

"The object of the test was to ascertain the exact composition of the milk from the individual cows of a herd, as also of their mixed milk at times when similar conditions of feed were general throughout the State, in place of special feeding or special selection of cows, to ascertain just what the analyst or milk inspector might expect to find in examining milk. Probably nearly all of the more than 100,000 cows in the State were at those dates feeding very much the same, and this milk, allowing for the difference in breeds and some local conditions, would represent the average quality of milk better than could be secured at any other time. Aside from the three Holsteins, the herd were all Ayrshires or Ayrshire grades, graded on high grade Devons, retaining but small proportion of Devon blood."

MECHANICAL SOIL-ANALYSIS.

INTRODUCTORY BY THE DIRECTOR.

It is a fact that while the chemical study of soils has led to general results of the greatest agricultural importance, very little practical benefit is commonly obtained from the analysis of any special soil beyond the detection of some deleterious ingredient or proving the relative deficiency of one or more needful elements. In most of the cases where this Station has undertaken to make soil-analyses the results have probably disappointed those who supplied the samples. An obvious defect of the ordinary chemical analysis lies in the fact that it can give at the best, a very imperfect or one-sided view of the nature of the soil. Two soils may agree fairly in chemical composition and yet differ extremely in their fertility. Again two soils may be about equally productive and yet have very unlike chemical composition. The physical characters of a soil—the texture, porosity, tenacity, amenability to tillage, retentiveness for water, capacity for heat, etc., equally with the chemical composition, influence its productiveness and value. For a long time these considerations have been appreciated and various attempts have been made to take account of the physical qualities of soils. Of late years much attention has been deservedly bestowed upon their mechanical analysis, i. e. separating them into various grades, according to the dimensions of the particles that compose them. Such mechanical analysis is in most cases essential to any conclusive investigation of a soil, it is especially important in studying the causes of the different value of those soils whose chemical analysis gives nearly the same results.

These reasons have led the Station to undertake a thorough study of the methods that have been recently employed in separating soils into their mechanical elements. The results already arrived at are very promising. Dr. Osborne has developed a new system of Beaker-elutriation which we think is a distinct advance upon the older methods, as respects simplicity of apparatus and procedure, economy of time and accuracy of conclusions. It is hoped that in future Annual Reports results of the useful application of this method to the study of our soils may find place.

THE METHODS OF MECHANICAL SOIL-ANALYSIS.

BY THOMAS B. OSBORNE, PH.D.

The following pages are a record of results so far obtained in investigating the processes that have been recently employed for separating soils mechanically into clay and various grades of sand and silt, with a view to the adoption of a method suitable for use in the study of Connecticut soils. It was at first proposed to make a comparison of three methods, viz: Schœne's, Hilgard's and Knop's as modified by Dr. G. E. Moore. While awaiting the construction of Hilgard's elutriator, and the arrival from Germany of Schœne's apparatus, the third above-named method was first examined. It is described by Dr. Moore, in his paper on "Tobacco Soils," in the final report of the 10th U. S. Census, vol. iii, pp. 872–3.

The Knop apparatus consists of a set of metal sieves with round holes of 3, 1, 0.5 and 0.25 millimeters diameter respectively, and a cylindrical glass jar of 36 millimeters caliber, carrying four lateral narrow tubes at intervals of 10 centimeters which may be opened or closed at pleasure by means of rubber tubes and clamps.

In Knop's process the soil is weighed out, boiled, and after removing with sieves all portions coarser than ¼ of a millimeter in diameter, is placed in the cylinder and water added till its level is 10 centimeters above the upper side tube. The cylinder is then closed with a rubber stopper, shaken violently, set up as nearly vertical as possible and the soil allowed to settle for 5 minutes. The upper side tube is then opened and the water and fine sediment drawn off. At intervals of 5 minutes the other side tubes are opened successively. The cylinder is then refilled, and these operations are repeated. The process is continued until no turbidity is seen in the water drawn off. The sediment remaining in the cylinder is called by Knop "fine sand," that deposited from the washings "dust."

Dr. Moore, in the Census Report, calls attention to the fact that the "fine sand" thus obtained by following Knop's method can be of no definite grade, for the reason that as the particles settle they continually collide and interfere with one another and hence do not subside with velocities strictly depending on their dimenlarger quantities of water are employed. Beakers of about 100^{cc} capacity are convenient for the coarser grades, but it is necessary to use larger vessels for the fine sediments from which turbid water accumulates that cannot be thrown away, as may be done with the clear water, from which the coarse sediments settle out completely in a short time.

It is best to keep the amount of water as small as possible in working out the dust since loss is incurred in using too large quantities.

Measurement of the Particles.—The measurement of the particles requires a little practice on account of the confusion occasioned by the organic matters and mica. One soon learns, however, to distinguish between these and the *quartz grains whose average diameter is properly taken as the standard.* In order to determine the size of *particles in suspension* we have found it convenient to apply to the surface of the liquid a small glass tube, in such a way as to take up a single drop, which is transferred to the glass slide. This drop will contain the smallest particles in the liquid. To obtain a sample of the coarsest particles the liquid is allowed to stand long enough to form a very slight sediment, and a portion of this sediment is collected with the glass tube. To determine the diameter of the *particles in a sediment,* it is stirred up vigorously with a little water and the pipette at once applied to the surface of the water. The drop thus taken contains the small particles. On decanting off the greater part of the sediment, the large particles remain at the bottom of the beaker and may be easily examined.

Time.—The time required to make the separations above described, is about two hours for each, so that an analysis including the siftings, is made in five or six hours, exclusive of the time necessary for collecting the dust and separating the clay, for which a subsidence of twenty-four hours has been allowed.

Weighing.—The sediments have been prepared for weighing by allowing them to subside completely, decanting off the clear water as far as possible, rinsing them into a weighed platinum dish, and igniting. Care must be taken in cooling the ignited sediments as they are exceedingly hygroscopic.

Beaker-Elutriation of Sandy Soils.—The working of this method is illustrated by the subjoined results of repeated analyses obtained on sandy drift-soil from the garden of the Experiment Station. These are the first analyses made while acquiring experience of the method. In order that the several elutriations may be strictly compared and that the variations arising from the sifting process and clay-separation may be eliminated, the results given below have been calculated in the following manner: The average amount removed by the sieves was carefully determined in several trials, and the difference between this average and the amount removed by the sieves in each analysis was noted. When more than the average amount remained on the sieve, the noted difference was added to the coarsest grade separated by elutriation, when less remained on the sieve, the difference was subtracted from this grade. It rarely happened that less remained and then only a few hundredths of a per cent. for the chief source of error in sifting arises from the difficulty with which the last portions pass through the sieve. These last portions consist of particles having diameters nearly the same as, or in some directions even greater than the holes of the sieve, and hence the differences due to their imperfect removal properly fall on the coarsest grade subjected to elutriation. All errors due to incomplete separation of the clay fall on the finest grade, and therefore this grade, together with the clay, is here calculated by difference.

Surface Soil, Garden of Experiment Station, Not Boiled.

Two Elutriation-products.

	No. 5.	No. 8.	No. 13.	No. 14.	No. 15
Removed by sieves	48.82	48.82	48.82	48.82	48.82
.25 .01^{mm}	36.84	36.35	35.70	36.53	35.98
.01 0^{mm} (by difference)	7.51	8.00	8.65	7.82	8.37
Loss on ignition of the soil	6.83	6.83	6.83	6.83	6.83
	100.00	100.00	100.00	100.00	100.00

The maximum differences above amount to 1.1 per cent. of the soil. In the subjoined analyses we have three elutriation-products on unboiled soil with greatest difference of 2.2 per cent.

	No. 13.	No. 14.	No. 15.
Removed by sieves	48.82	48.82	48.82
.25 .05	21.06	23.28	22.77
.05 .01	14.64	13.25	13.21
.01 0 (by difference)	8.65	7.82	8.37
Loss on ignition of the soil	6.83	6.83	6.83
	100.00	100.00	100.00

The Effect of Boiling.—As it is now generally considered indispensable to boil a soil for some time before subjecting it to mechanical analysis, a number of analyses were made after boiling the samples for 23 hours with water substantially as recommended by Hilgard. The results obtained are as follows:

SURFACE SOIL, GARDEN OF EXPERIMENT STATION. Boiled for 23 hours. Two elutriation-products. Greatest difference 2.2 per cent. of soil.

	No. 6.	No. 7.	No. 9.	No. 16.	No. 17.	No. 18.
Removed by the sieves	47.77	47.77	47.77	47.77	47.77	47.77
.25 .01	33.34	32.85	32.84	31.47	32.25	31.15
.01 0 (by difference)	12.06	12.55	12.56	13.93	13.15	14.25
Loss on ignition of the soil	6.83	6.83	6.83	6.83	6.83	6.83
	100.00	100.00	100.00	100.00	100.00	100.00

Three elutriation-products. Greatest difference 2.3 per cent.

	No. 9.	No. 16.	No. 17.	No. 18.
Removed by the sieves	47.77	47.77	47.77	47.77
.25 .05	20.40	21.34	20.59	20.66
.05 .01	12.44	10.13	11.66	10.49
.01 0 (by difference)	12.56	13.93	13.15	14.25
Loss on ignition of the soil	6.83	6.83	6.83	6.83
	100.00	100.00	100.00	100.00

In the foregoing analyses "clay" has not been considered independently of "dust," in the product of .01 to 0^{mm} diameter.

Comparison of results on soil boiled, soil not boiled and soil simply pestled.—The effect of boiling on the surface soil of the Experiment Station garden is most clearly seen from the subjoined comparison of the averages of the foregoing more detailed analyses of that soil.

No. 29 is an analysis made on a sample of this soil not boiled in which the sediments were, at the last, worked under a soft rubber pestle by gentle pressing down (but not grinding around), so long as such treatment appeared to detach any fine particles.

The figures for clay in the following statement are reckoned by difference or loss after the other ingredients had been obtained by direct weighings.

SURFACE SOIL FROM EXPERIMENT STATION GARDEN.

	Av. of 4 analyses. Boiled.	No. 29. Pestled.	Av. of 3 analyses. Not Boiled.
Removed by sieves	47.77	48.82	48.82
.25 .05	20.75	22.44	22.37
.05 .01	11.18	12.55	13.70
.01 0	10.72	7.36	7.20
Clay (by difference)	2.75	2.00	1.08
Loss on ignition	6.83	6.83	6.83
	100.00	100.00	100.00

The effect of boiling sandy soils is further illustrated in the following instances:—

SUB-SOIL FROM EXPERIMENT STATION GARDEN.

		No. 19. Not Boiled.	No. 20. Boiled.	No. 21. Boiled.
Removed by sieves		41.60	39.33	39.33
.25	.05	35.93	32.35	32.95
.05	.01	12.13	10.32	10.37
.01	0 (by difference)	5.24	8.29	7.64
Clay (direct)		1.02	5.63	5.63
Loss on ignition		4.08	4.08	4.08
		100.00	100.00	100 00

SANDY LOAM FROM DURHAM, CONN.

	No. 12. Not boiled.	No. 10. Boiled 28 hours.
Removed by sieves	16.19	14.07
.25–.05	29.52	25.10
.05–.01	23.17	23.12
.01–0	9.65	15.42
Clay (by difference)	1.67	2 49
Loss on ignition	19.80	19.80
	100.00	100.00

The analyses of these sandy soils show a very decided increase in the quantity of particles smaller than .01 mm. diameter at the expense of those coarser, as a result of boiling. The surfaces of the coarser particles which have been boiled are seen to be polished and of a lighter color than those not boiled. The surfaces of the unboiled grains are coated with a film of fine material cemented to them probably by clay. When these coarse particles which have not been boiled are violently stirred with water for a short time no fine particles are detached from them, and a careful examination under the microscope fails to reveal in any of the sediments more than an occasional grain exceeding the .05 mm. limit by so much as .01 mm., or the .01 limit by .005 mm. It would therefore appear that these small particles thus set free by long boiling are really a part of the larger ones, and should be treated as such in a mechanical analysis of these soils.

In case of the pestled soil No. 29, there is a gain on clay and a loss on the .05–.01 mm. sediment of about one per cent. as compared with the unboiled soil, but as the intermediate grade is quite the same in both, the difference is not due so much to scouring of the sediments as to their unlike separation. In fact, the pestling was seen to release very little fine matter from the sediment as first elutriated.

In the analyses that follow the soils were simply pestled.

No. 36, Sandy Loam, Drift Soil, Deer River, New York. A fairly good soil when treated with stable manure.

No. 38, "Blowing Sand," Alluvial Soil, valley of Connecticut River, East Windsor, Conn. Twenty-five years ago considerable tracts of this soil, which had been "skinned" by constant cropping with rye until the yield was reduced to 8 to 10 bushels per acre once in two or three years, were lying waste and in exposed situations drifted with the winds, but having bottom-water at the depth of a few feet were readily reclaimed by means of clover-seed and sheep.

No. 39, "Clay Soil," East Windsor. An alluvial silt so fine as to pass for clay.

	Sandy Loam. No. 36.	Blowing Sand. No. 38.	"Clay Soil." No. 39.
2. mm–1. mm	1.57	1.18	----
1. – .5	3.15	3.44	----
.5 – .25	27.30	12.86	1.22
.25 – .05	40.77	68.62	6.81
.05 – .01	8.38	4.46	69.11
.01 – 0	8.07	6.30	17.83
Clay	2.00*	0.25*	2.97*
Loss on ignition	7.66	3.06	2.60
	98.90	99.92	100.54

* Direct.

Comparison of Beaker Elutriation with Hilgard's Churn Elutriation.

The churn elutriator employed, while differing somewhat in the details of its construction from that originally described by Prof. Hilgard, (Am. Jour. Sci., Oct. and Nov. 1873), closely follows that description in all essential points, and has very nearly the same interior dimensions. The body of the instrument was cast from nickel bronze so as to resist the wear of sediments. The axle bearing the grated wings passes through a stuffing box packed with greased cotton like those employed in steam engines. The other end is covered by a cap which screws water-tight over the end of the axle. By these means leakage is entirely prevented. Just above the axle the spherical body is divided horizontally into two parts which fit together accurately, the upper part screwing into the lower. This gives opportunity of cleaning the instrument. The interior is carefully turned to a hollow sphere of the dimensions indicated by Hilgard. The glass cylinder is fastened by a collar which screws into the body. The grated wings were cast from nickel bronze and patterned from a drawing kindly furnished by Prof. Hilgard. The instrument has two strong legs with broad feet, cast as part of the body, and the latter were carefully planed so that the instrument stands vertically when secured upon a level table. A glass reservoir is attached as described by Hilgard, and this communicates with a constant-level water tank. The rate of water supply is regulated by a cock, as Hilgard recommends. Motion is communicated to the grated wings by means of a pulley at the end of the axle which is belt-geared to a water motor. The instrument thus constructed* has proved entirely satisfactory, having been in operation for many weeks without serious leak or wear.

Results on Sandy Soils.—The following tables give analyses of coarse soils by the two methods of beaker and churn elutriation, the samples being alike prepared by boiling for 23 hours:

SOIL FROM EXPERIMENT STATION GARDEN.

Surface soil—boiled 23 hours.

	Churn Elutriation.		Beaker Elutriation.
	VII.	VIII.	Average of four analyses.
Removed by sieves..	47.77	47.77	47.77
.25–.05	22.06	21.95	20.75
.05–.01	11.20	11.62	11.18
.01–0	9.82	9.14	10.72
Clay (difference)	2.32	2.69	2.75
Loss on ignition	6.83	6.83	6.83
	100.00	100.00	100.00

Subsoil—boiled 23 hours.

	Churn Elutriation.		Beaker Elutriation.	
	X.	XI.	20.	21.
Removed by sieve	39.33	39.33	39.33	39.33
.25–.05	33.61	30.83	32.35	32.95
.05–.01	10.91	12.25	10.32	10.37
.01–0	7.05	8.11	8.29†	7.64†
Clay	5.02†	5.40†	5.63	5.63
Loss on ignition	4.08	4.08	4.08	4.08
	100.00	100.00	100.00	100.00

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* By Mr. J. M. Beers, machinist, New Haven.

† By difference.

These analyses agree quite as well as could be expected for two such different methods.

According to Hilgard the results of duplicate churn elutriations usually agree within 5 per cent. of the amount of the sediment. Greater practice in working the churn elutriator will doubtless enable us to obtain more concordant percentages than those here given, which are first attempts.

The comparison we think sufficiently demonstrates that the method by beaker elutriation may properly assume equal rank, in respect to accuracy of separation, with that of Hilgard.

Several attempts were made to use the churn elutriator on these coarse soils without previously boiling, but, like Hilgard, we did not succeed in obtaining uniform results—evidently because the rapid and long continued churning of the soil has the same scouring effect on the sand grains that has been shown to be a result of protracted boiling, and there is consequently a continual abrasion and delivery of fine material throughout the entire elutriating process.

It is difficult to remove all the fine material even on a boiled sample of soil with the churn elutriator, but after some hours the amount passing off with the water is so trifling that the error due to this cause may be neglected. Microscopic examination of the sediments shows a very good separation indeed.

It is important to have water very free from any suspended matter in order to maintain a uniform current. It was found necessary to use distilled water for the low velocities, as the pipe water of the laboratory, although apparently clear, soon clogged the stop-cock.

Elutriation of Clayey Soils.—In applying beaker elutriation to tenacious fine-textured soils the matter of preliminary treatment had to be considered from the outset since Hilgard found that his churn elutriator gave no concordant or satisfactory results on clays without long boiling and subsequent "kneading" of the finer sediments. The first clay-soil examined is the one occurring at North Haven, Conn., which is extensively used in brick manufacture. The air-dry soil analyzed is reddish-brown in color, the lumps have but moderate coherence, being mostly crushed with ease between the fingers. It effervesces moderately with acids, and is fusible at high temperatures. A sample of this soil was boiled 23 hours and subjected to sifting and to beaker elutriation. On examining the sediments microscopically it was found that they contained many aggregations of extremely small particles which broke into "dust" under the pressure of the thin glass slide-cover. The sediments were then gently crushed or pestled in the beakers with help of a soft perforated rubber stopper (with a glass rod for handle), grinding together of the particles being as much as possible avoided. This pestling was continued with addition of clear water as long as it occasioned turbidity..

Other samples of the unboiled soil were subjected to the same treatment. Comparison of the analyses which follow shows that practically identical results are thus obtained *on this particular soil*, whether it be boiled or not, and indicates that the sediments are reduced to their elements by gentle pestling alone.

As above stated, simple boiling for 23 hours failed to break up the clay of this soil to any adequate extent.

The subjoined percentages were obtained in elutriation of different portions of the North Haven clay. The loss on ignition was ascertained in a special trial. In No. 27 all the determinations except loss on ignition, were made directly on one sample. In XII clay is reckoned by difference.

BRICK CLAY, NORTH HAVEN, CONN.

	Not Boiled.			Boiled 23 hours.		
	Beaker Elutriation.					Churn Elutriation.
	Thoroughly Pestled				Slightly Pestled.	Not Pestled.
	No. 24.	No. 25.	No. 27.	No. 28.	No. 26.	XII.
Removed by sifting	3.41	3.27	3.49	3.49	3.41	3.36
.25–.05^{mm}	1.61	1.50	1.29	1.42	1.41	1.21
.05–.01	26.24	27.21	27.02	26.36	30.46	28.27
.01–0			52.21			56.29
Clay			10.15			4.92
Loss by ignition			5.95			5.95
			100.11			100.00

We notice that the figures for the first two grades agree substantially throughout. The sediments .05–.01^{mm} in all the thoroughly pestled samples, boiled or unboiled, accord to within 1 per cent. The churn-elutriated sediment is 1½ per cent. higher, the slightly pestled sediment is 4.7 per cent. higher than the average of the thoroughly pestled sediments of the same grade.

In No. 27 the two grades .01–0^{mm} and clay were carefully worked over until their separation was carried to the furthest practicable limit or until the clay contained but a trifling proportion of measurable particles. Professor Hilgard insists that in some soils at least 30 hours lively boiling and repeated *kneading* of the finer sediments is indispensable for their reasonably complete separation. The comparison between No. 27 and XII is therefore not one of beaker- vs. churn-elutriation, so much as one of pestling vs. 23 hours boiling and subsequent churning.*

With exception of the clay, the sediments consist essentially of water-worn quartz grains, in all respects except size, similar to those of the soil from the Experiment Station garden. The clay is in fact an alluvial deposit in the former bed of the Quinnipiac river, derived from the same drift which constitutes the soil of the Experiment Station garden.

In case of No. 27, the sediments .05–.01 and .01–0 were each further divided into two grades. The more detailed analysis is as follows:—

BRICK CLAY, NORTH HAVEN, CONN.

	Detailed analysis. Thoroughly pestled.
Removed by sifting	3.49
.25–.05	1.29
.05–.02	7.21
.02–.01	19.81
.01–.005	22.02
.005–.0	30.19
Clay	10.15
Loss on ignition	5.95
	100.11

The soil next examined was a clay loam from Deer River, N. Y., of very different characters, containing a considerable proportion of water-worn fragments of soft and superficially disintegrated slaty rocks. On this account it serves well for studying the processes that may be used in the treatment preparatory to mechanical analysis.

---

* I have not attempted to employ kneading or pestling in connection with churn-elutriation. It is evident that the pestling of 15 to 30 grams of soil at once, *preliminary* to elutriation, is objectionable, because the operator has no ready criterion for deciding, either when the process has gone far enough to break up aggregated particles of soil, or when it has reached the point of pulverizing fragments of soft rock. To knead and work over in the churn-elutriator, the sediments that have once passed it, would be effectual but very tedious. In beaker elutriation pestling is much more easily applied to finish the sediments that have been already obtained approximately pure, and the turbidity produced in the small portions of clear water used, indicates the effect of the pestling and shows how far to carry it.

CLAY LOAM, DEER RIVER, LEWIS CO., NEW YORK.*

	Beaker Elutriation.				Churn Elu'n.
	Not boiled but thoroughly pestled.		30 grms. boiled 23 hours with 350 c. c. water in ½ liter flask.		15 grms. boil'd 23 hours with 600 c. c. water in 1 liter flask.
	No. 30.	No. 31.	No. 32.	No. 34.	XIII.
Removed by sifting	20.92	19.91	14.69	13.89	17.94
.25–.05	17.96	18.41	18.12	18.83	19.32
.05–.01	25.26	26.94	21.42	19.40	24.66
.01–0.	23.05	22.00	28.14	33.13	24.25
Clay	3.55	4.75†	9.39	6.76†	5.84†
Loss on ignition	7.99	7.99	7.99	7.99	7.99
	98.73	100.00	99.75	100.00	100.00

The above analyses plainly demonstrate that for this soil pestling is a much safer treatment than boiling. Pestling gives 20.42 per cent. of material larger than $.25^{mm}$ as the average of two determinations that differ 1 per cent. Boiling for 23 hours abrades these fragments of shale and slate to the extent of 2.5 per cent. when 15 grams of the soil are boiled in 600^{cc} of water, while, when 30 grams are boiled in but 350^{cc} of water, the scouring amounts in two trials, to 5.7 and 6.5 per cent. respectively.

The first sediment, $.25\text{–}.05^{mm}$, is remarkably alike in amount in all the elutriations, the extremes differing but by 1.4 per cent. This fact indicates that in boiling it yielded as much to the finer grades as it gained from those coarser, or else that it consisted of quartz sand which suffered no considerable change. It does in fact largely consist of colorless transparent quartz grains, but these are intermixed with others of a brown color, some translucent on the edges and others quite opaque, and all the sediments except "clay" are quite alike in appearance under the microscope, both from the unboiled and boiled soils. To the unassisted eye the boiled sediments seen in mass, are whiter or lighter in color than those unboiled, evidently the result of scouring of the sand grains. In the part removed by sifting many fragments of slate or shale are to be seen, but none are detectable in the finer grades. It would appear therefore that when the weathered slate and shale get reduced to near 1^{mm} in thickness they lose all coherence and fall to sand, dust or clay. The brown, partly transparent, partly opaque particles, are probably bits of fine-grained argillaceous sand rock from the Lorraine Shales. The fragments of this rock apparently break up by the attrition of boiling, into the sand-grains of various dimensions from which the rock was originally formed.

---

* *Note by the Director.*—This very superior soil was selected for mechanical analysis because the Director was formerly for years quite familiar with its qualities under tillage and cropping as well as with the geological elements from which it is formed. When the sample was taken, some 25 years ago, this land was and for more than 30 years had been capable of yielding 30 to 40 bushels of wheat per acre without manure. It had excellent texture, admitted of easy tillage when not too moist, was naturally well drained by the admixed and underlying gravel, and yet was retentive of moisture and suffered little under drouth. It retains to this day a high repute. The soil lies at the confluence of the Deer River with Black River and is an alluvium formed partly from the granitic drift that covers the adjacent higher land and partly from the disintegration of the soft rocks of the Lower Silurian that overlie each other in a long stretch of terraces and hills to the westward. Through these rocks Deer River and other tributaries of Black River have cut deep channels, and the soil contains a considerable proportion of water-worn gravel stones up to 2 inches or more in diameter, but commonly less than ½ inch in thickness, with well-rounded edges, derived from the Trenton Limestone, the Utica Slate, and the Lorraine Shales of the New York geologists. The soil as analyzed had been freed by sifting from material coarser than 2^{mm} diameter and contained 5.4 p. c. from 2 to 1^{mm}, 6.3 p. c. from .1 to $.5^{mm}$, and 9.2 p. c. from .5 to $.25^{mm}$.

† Clay and loss, by difference. All other determinations are direct.

In the $.05–.01^{mm}$ sediment the scouring effect of ebullition is again manifest and is evidently greater, as the friction of the grains of soil upon each other is increased by diminishing the volume of water with which they are boiled.

The matter detached by boiling from the foregoing grades is found in the two following, which in the extreme cases are 5.6 and 10.6 per cent. above the corresponding ones obtained from the unboiled but pestled earth.

The "clay" in analyses 30 and 32 as given above, was separated from silt $(.01–0^{mm})$ by 24 hours settling of the latter.

The following analysis was made on the fine earth of a fertile soil, from South Onondaga, New York, which originally contained a considerable proportion of slaty gravel and was derived in part from the limestones, slates and shales of the Upper Silurian and Lower Devonian. It is seen to be very similar in structure as it is in geological character to the clay loam from Deer River.

WHEAT SOIL, SOUTH ONONDAGA, NEW YORK.

	Beaker elutriation. Thoroughly pestled. No. 37.
Above 1^{mm}	6.96
.1–.5	5.45
.5–.25	5.17
.25–.05	9.07
.05–.01	26.35
.01–0	29.43
Clay, by difference	8.10
Loss on ignition	9.47
	100.00

The last analyses to mention in this paper have been made on an extremely fertile Prairie Soil.

Prairie Soil from Mercer Co., Ill.

	Thoroughly pestled.		Boiled 23 hours.
	No. 33.	No. 34.	XIV.
Siftings	.62	.92	.57
.25–.05	2.42	2.89	5.69
.05–.01	43.58	42.86	46.95
.01–0.	31.58	31.44	26.74
Clay	5.81	7.40*	5.56*
Loss on ignition	14.49	14.49	14.49
	98.50	100.00	100.00

* Clay and loss, by difference.

Here again, in a soil consisting almost entirely of matter finer than .05 mm., long boiling and churning are quite insufficient to prepare properly for elutriation. The cementing material in this prairie soil is evidently, to a large extent organic matter. The churn-elutriated sediments were all black. The first two sediments in the other analyses were nearly white after pestling, the organic matter in company with the finest mineral substance being thus transferred to the last two grades.

The trials made thus far appear to justify the following conclusions:

1. On sands and silts of pure quartz or similar resistant material Hilgard's method and Beaker elutriation give practically identical results.

2. With coarse sands and silts upon whose grains finer matter has been cemented by silicates, etc., and with soils containing soft slaty detritus, the churn elutriator with preliminary boiling may give results too low for the coarse and too high for the finer grades. In these cases beaker elutriation with pestling yields more correct figures.

3. Some loamy soils containing no large amount of clay or of extremely fine silt, as well as prairie soils rich in humus, cannot be suitably disintegrated by 24 hours' boiling, but are readily reduced by pestling.

4. Beaker elutriation preceded by sifting, gives results in 5 or 6 hours with use of 2 to 3 gallons of pure water, which in churn elutriation require several days and consume 7 to 10 gallons of pure water.

5. Hilgard "found that practically $0\cdot25^{mm}$ is about the lowest velocity" (of water-current per second) "available within reason-

able limits of time" in his elutriator. Such a current carries over particles up to $\cdot 015^{mm}$ diameter and hence the silts of less dimensions cannot be conveniently separated by churn elutriation. In beaker elutriation there is no difficulty in making good separations at $\cdot 01^{mm}$ and at $\cdot 005^{mm}$.

6. Beaker elutriation requires no tedious boiling or preliminary treatment and with careful pestling of the sediments gives, we believe, as nearly as possible, a good separation of adhering particles and at every stage of the process carries with it, in the constant use of the microscope, the means of testing the accuracy of its work and of observing every visible peculiarity of the soil. It is not claimed that pestling may not easily go too far, but in any case a good judgment may be formed of its effects and of the extent to which it is desirable to carry it.

7. In beaker elutriation the flocculation of particles occasions little inconvenience and does not impair the accuracy of the results.

Further investigations are required on the fine matter of stiff clays and of soils rich in humus. Such it is contemplated to undertake immediately.

Before concluding this paper I must acknowledge my constant indebtedness to Prof. Hilgard and to Dr. Moore for the assistance derived from their publications and for the descriptions, sketches and apparatus supplied by them to this Station, which have been available for my work.

Time has not as yet permitted any extended study of Schöne's method as practiced by Orth, Fesca and Wahnschaff, and we can only say, from a few trials in its use, that it is certainly open to very serious objections, as Hilgard has pointed out.

NOTES ON ANALYTICAL METHODS.

By Dr. T. B. Osborne.

Filtration of Crude Fiber.

The filtrations in the process of determining crude fiber are commonly quite difficult and tedious, the acid liquids especially, either running turbid through a coarse filter or clogging a fine one. In most cases these troubles may be avoided by using the filter pump and a paper filter supported on a platinum cone and by breaking the filter down the fold or crease, on one side. This is done by folding the paper so as to form a cone of an angle slightly less acute than the funnel, placing it in the latter, moistening and then applying the suction when the paper will usually tear apart, leaving a narrow rift from the vertex upward, across which stretches a loose network of fibers. If the sample has not been too finely ground it may be filtered clear by shaking or stirring up thoroughly and throwing quickly on to the paper so that the coarser particles will hold the finer and prevent the latter from passing the rift or clogging the paper. The break allows the solution to run off rapidly so that in most cases but three or four minutes are necessary to conclude the filtration.

This method has given good results in crude fiber determinations with hay and bran-feed and with sheep-dung, which were very difficult to manage by the usual methods.

Filtration and Weighing of Silver Chloride.

Solutions containing organic matter are often very difficult to filter from silver chloride, this precipitate at first running through and afterwards clogging the paper so as to make the filtration slow. The removal of the precipitate from the paper and the conversion of the reduced silver obtained after burning into chloride again, are operations taking considerable care and time. In many cases it is better to allow the precipitate to settle and to decant the greater part of the liquid through a Gooch asbestus filter. The precipitate is then dissolved in a very slight excess of ammonia water, the concentrated solution being thereupon made slightly acid with nitric acid, the precipitate will separate in a flocky form, which after carefully washing by decantation may be thrown on to the filter and sucked dry with the pump without danger of running through. If the precipitate be fused it is somewhat difficult to remove from the crucible, but it may be dried at 100°, at which temperature a constant weight is obtained in from a half to one hour.

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STATE OF CONNECTICUT.

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1892, Apr. 30.
Exper. Station.

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Executive Committee. (T. S. Gold, W. H. Brewer, S. W. Johnson)

Chemists.

E. H. JENKINS, PH.D., *Vice-Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, JR., PH.B.
T. B. OSBORNE, PH.D.

In charge of Buildings and Grounds.

CHARLES J. RICE.

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, milk, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, etc., etc., for the citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described and retail prices given on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 23.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in duly authenticated samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be *prepaid*, and all communications should be directed, *not to any individual officer*, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban st., between Whitney avenue and Prospect st., 1⅜ miles North of City Hall. Suburban st. may be reached by the Whitney ave. Horse Cars, which leave the corner of Chapel and Church sts. three times hourly, viz., on the striking of the clock and at intervals of twenty minutes thereafter.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State st., or from Peck and Bishop's Office in Union R. R. Depot.

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REPORT OF THE BOARD OF CONTROL.

To His Excellency, Phineas C. Lounsbury, Governor of Connecticut:

In accordance with the law establishing the CONNECTICUT AGRICULTURAL EXPERIMENT STATION, as amended by Chapter V, Sec. 20 of the acts of the last General Assembly, the Board of Control herewith submits its Annual Report. The Report of the Director will show that the work of the Station has gone on without interruption during the twelve-month just completed. Two hundred and ninety analyses of fertilizers, twenty-two of feeding stuffs, eight of potatoes, eight of insecticides and a number of analyses of miscellaneous articles will be included in his Report, and a large amount of efficient work has been done besides, in testing and improving methods and appliances for the analysis of fertilizers, soils, and feeding stuffs. The chemical work required by the Dairy Commissioner has been done at the Station. A field experiment has been carried out to test the agricultural value of certain phosphates, and a Forage Garden on the Station grounds has been established for the study of problems connected with the improvement of meadows and pastures. These subjects will be fully discussed in the Report of the Director which is in an advanced state of preparation, and will be ready for publication early in 1888. The Report of the Treasurer herewith presented exhibits the financial affairs of the Station for the last fiscal year. The Board of Control has held one special meeting relating to the Experiment Station bill which was passed by the 49th Congress and the Executive Committee has also held two meetings. The Board appointed delegates to a National Convention of representatives of Agricultural Colleges and Experiment Stations held in Washington, Nov. 22–24, called for the purpose of concerting measures to remedy a defect in that bill which failed to provide the special appropriation it was intended to make. It is now confidently expected that funds from this source will shortly be available for the use of this Station.

All which is respectfully submitted:

WM. H. BREWER, *Sec'y.*

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with the Connecticut Agricultural Experiment Station.*

July 1st, 1886 to June 30th, 1887.

Receipts.

Balance from old account	$192.88	
From Comptroller	8,000.00	
Analysis Fees	3,759.48	
Miscellaneous Receipts	97.45	
		$12,049.81

Expenses.

Salaries	$6,925.52	
Laboratory expenses	1,528.39	
The Buildings, Grounds and Establishment, repairs, etc.	1,023.06	
Printing	358.33	
Stationery	102.54	
Postage	219.43	
Library	188.79	
Collecting Fertilizers	468.97	
Traveling expenses of the Board of Control	29.12	
Telephone	100.15	
Water	132.00	
Gas	292.06	
Fuel	28.75	
Herbarium	198.30	
Special Grass investigation	202.70	
Miscellaneous sundries	248.31	
Balance on hand	3.39	
		$12,049.81

Memorandum.

There is due the Station ninety (90) dollars for laboratory work.

WILLIAM H. BREWER, *Treasurer.*

REPORT OF THE DIRECTOR.

Under the requirements of the State Fertilizer Law, the greater part of the time and labor of the operating force of this Station has been expended, as usual, in work connected with the collection and analysis of Commercial Fertilizers.

The total number of brands legally sold in the state during the past year has been 128. The law requires this Station to make and publish annually at least one analysis of each of these, while examinations of home-mixed fertilizers and waste-products have brought the total number of fertilizer analyses up to 291. These analyses have been performed by Messrs. Farrington, Winton and Osborne. During April and a part of May the Station employed as special agents, Messrs. E. C. Ellwood of Green's Farms and C. L. Gold of West Cornwall, who visited more than one hundred towns in Connecticut, and drew in all nearly 600 samples of fertilizers, reporting also any cases where the requirements of the law appeared not to be fully met.

Twenty-two analyses of feeding stuffs have been made and the results of all accessible American analyses of this kind which have been published during the year have been tabulated by Dr. Jenkins and will be found in this Report.

Eight analyses of potatoes have been executed and incidental to this work a considerable amount of labor has been expended in comparing the different methods currently employed for determining starch. The results of this investigation by Mr. Winton appear in the following pages.

Six samples of Paris Green, now largely used on fruit trees as an insecticide, have been analyzed by Dr. Osborne for the purpose of determining their purity.

One sample of milk and one of the internal organs of a cow have been examined for suspected poisons, in both cases with negative results.

At the request of Hon. J. B. Tatem, Dairy Commissioner, the Station has made chemical examination of 34 samples of suspected butter, all but one of which proved to be imitation butter.

A law passed at the last session of the General Assembly provided for the inspection of molasses by the Dairy Commissioner. The Commissioner applied to the Station to make the necessary examinations of suspected samples. The Director was unprepared on his own responsibility to accede to the Commissioner's request, and for the following reasons :—

1. The first section of the Act creating the Station declares "That for the purpose of promoting agriculture by scientific investigation and experiments, an institution is hereby established, to be called and known as The Connecticut Agricultural Experiment Station." Since molasses is not made in this State and is not an agricultural but a manufacturing product it is evident that its analysis for the purpose of discovering adulteration is no more the proper duty of this Station than the study of the adulterations of any other article of general consumption.

2. The Station would require to make a considerable outlay for study of the methods and for the purchase of apparatus necessary for testing molasses, and to judge from its experience with oleomargarine would have to give much of the time of its chemists to this work.

The question was therefore referred to the Executive Committee, and it was decided that since the law would otherwise remain without effect, the Station should coöperate with the Dairy Commissioner as far as due regard to its other obligations would permit. Through the courtesy of Dr. Cook, Director, and Dr. Neale, Chemist, Dr. Jenkins was enabled to avail himself of the extensive experience in sugar analyses which these officers of the New Jersey Station have enjoyed, and spent some time at New Brunswick with their coöperation and assistance, in mastering the methods applicable to testing the purity of molasses. The Station has obtained from Germany the needful instruments for sugar-analysis, including a Polarimeter of the most improved construction (Halbschatten Polarisations-Apparat mit doppelter Keilcompensation, von Schmidt & Haensch). As yet but few examinations of molasses, have been completed for the Commissioner.

In continuation of his work, begun in 1886, Dr. Osborne has made further valuable contributions to the study of Methods of Mechanical Soil-Analysis and his results are included in this Report.

Mr. Farrington has made an elaborate comparison of Jodlbauer's modification of the Kjeldahl process of determining nitrogen, with the absolute method. His results are detailed in this Report.

Under arrangement with Mr. W. I. Bartholomew of Putnam a very instructive field experiment has been skilfully carried out to test the comparative value of certain phosphates on the corn crop, and in connection therewith a series of analyses have been made to determine the total quantities both of cattle food and mineral matters removed from an acre in the corn crop. Plans for performing a similar experiment which had been entered into were interrupted by the decease of Mr. Fairchild of Middletown.

In the latter pages of this Report will be found an account of the Forage Garden at this Station which was begun in September of 1886. The object in view in establishing this Garden and what has been accomplished thus far, are there set forth and need not be further noticed here. In carrying on that work the Station has been fortunate to be able to make avail of the very valuable and largely gratuitous services of Mr. J. B. Olcott, of South Manchester, who has labored for it and in it, with head and hands, in season and out of season. Mr. Farrington and Mr. Winton and especially Dr. Jenkins have contributed both mind and muscle to the care of this very troublesome but extremely interesting part of the Station grounds.

The Station has published and distributed in editions of 5000 copies, four printed bulletins, aggregating 49 pages. The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mailed to every post-office in the state. The package is directed to the postmaster, with a request to distribute to farmers. The number sent will be increased, in any case, on application. The distribution of these Bulletins is of course optional with the postmaster.

The Bulletins are also regularly sent to every Newspaper in the State, and to the Secretary of each Agricultural Society, Farmers' Club and Grange whose address is known to the Station.

The Bulletins are sent, also, on application, to any individual who wishes them. Such application, as a rule, must be renewed annually early in the year.

The Station has also issued fourteen Weekly Statements printed in a very limited edition by the hektograph process and supplied as far as possible to the agricultural press, and to Secretaries of farmers' clubs and agricultural societies.

The necessary Station correspondence increases from year to year and during the last twelve months has involved the sending of some 1500 manuscript letters and reports of analyses.

Besides receiving many calls from individual farmers the Station has been visited the last year by the Green's Farms Farmer's Club in a body and also by the Cheshire Grange, whose members to the number of seventy-five, came to the Station on an appointed day, bringing their lunch, and made a picnic on the Station grounds. It is hoped that other organizations of farmers will follow this example during the coming season. The Station officers will do all in their power to make visits interesting and profitable.

THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a Fertilizer Law which went into effect September 1, 1882, and which repealed and took the place of all previous legislation on this subject. The law is still in force without any amendment. Since a full understanding of the provisions and penalties of this law is important to all who buy or sell commercial fertilizers the law is here reprinted and attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a *certified statement* of composition. net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a *sealed sample* shall be deposited with him by the MANUFACTURER OR IMPORTER. Section 2.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

4. All "CHEMICALS" that are applied to land, such as : Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Lime (Gypsum or Land Plaster), Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 9 of the Act.

Here follows the full text of the law, with explanatory footnotes.

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

General Assembly,
January Session, A. D. 1882.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Printed statement to be affixed to all packages and to go with all lots.

Section 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

Before sale *certified copies* of statement, and *Sealed Sample* to be deposited with Director.

Sec. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said

director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

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* A statement of the per cents. of Nitrogen, Phosphoric Acid (P_2O_5) and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric Acid.

For Potash Salts give always the per cent. of Potash (potassium oxide); that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

Analysis Fee to be paid annually on or before May 1st.

Sec. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

Yearly Report to Station of Dealers or Agents.

Sec. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

Leather.

Sec. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

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* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

On receipt of statements, samples and analysis-fees, the Station will issue Certificates of Compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

Fish-guano, &c.

Sec. 6. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

Fines.

Sec. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

Fertilizers for private use.

Sec. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

Director's duties and authority.

Sec. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the station, and shall cause one or more analysis of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

Bulletins.

Sec. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

Repeal of former acts.

Sec. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed.

Sec. 12. This act shall take effect on the first day of September, 1882.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in section 9, that all fertilizers be analyzed and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

OBSERVANCE OF THE FERTILIZER LAW.

Manufacturers who have paid Analysis Fees as required by the Fertilizer Law, and Fertilizers for which the Fees have been paid for the year ending May, 1888.

Firm.	*Brand of Fertilizer.*
Adams, Wm. P., 248 Front St., N. Y.	Adams' Ammoniated Bone Superphosphate.
Adams & Thomas, Springfield, Mass.	Adams' Market Bone Fertilizer.
American Oil Co., 18 Broadway, N. Y.	Cotton Hull Ashes.
Apothecaries Hall Co., Waterbury, Conn.	Victor Phosphate.
H. J. Baker & Bro., 215 Pearl St., N. Y.	A. A. Ammoniated Superphosphate.
	Pelican Bone Fertilizer.
	Potato Fertilizer.
	Corn Fertilizer.
	Strictly Pure Ground Bone.
	Castor Pomace.
	Ground Bone.
Bennett, P. W., Rockfall, Conn.	Stockbridge Grain Manure.
	" Forage Crop Manure.
	" Vegetable Manure.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Bowker's Hill and Drill Phosphate.
	" Fish and Potash.
	" Ammoniated Dissolved Bone.
	" Dry Fish.
Bradley Fertilizer Co., 27 Kilby Street, Boston, Mass.	Bradley's Complete Manure for Potatoes and Vegetables.
	Bradley's Complete Manure for Corn and Grain.
	Bradley's Complete Manure for Top Dressing Grass and Grain.
	Bradley's Superphosphate.
	B. D. Sea Fowl Guano.
	Original Coe's Superphosphate.
	Circle Brand Ground Bone and Potash.
	Bradley's Potato Manure.
	Farmer's New Method Fertilizer.
	Pure Fine Ground Bone.
	Fish and Potash, Anchor Brand.
	" " " Triangle A Brand.
Clark's Cove Guano Co., New Bedford, Mass.	Bay State Fertilizer.
	Unicorn Ammoniated Superphosphate.
	King Phillip Alkaline Guano.
	Great Planet A Fertilizer.
	" " B "
Coe, E. Frank, 16 Burling Slip, N. Y.	High Grade Ammoniated Bone Superphosphate.
	Alkaline Bone.
	Red Brand Excelsior Guano.
	Ground Bone.
	Fish and Potash.
Coe, Russell, Tremley, N. J.	Ammoniated Bone Superphosphate.
Collier White Lead & Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford, Conn.	Collier Castor Pomace.
Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	Common Sense Fertilizer, No. 2.
	" " " No. 22.

Firm.	*Brand of Fertilizer.*
Cooper's, Peter, Glue Factory, 17 Burling Slip, New York.	Peter Cooper's Bone Dust.
Crocker's Fertilizer & Chemical Works, Buffalo, N. Y.	Ammoniated Bone Superphosphate.
	Potato, Hop and Tobacco Phosphate.
	Queen City Phosphate.
	Pure Ground Bone.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate.
Dambmann Bros. & Co., 13 German St., Baltimore, Md.	The Improved Blood Guano.
Darling, L. B., Fertilizer Co., Pawtucket, R. I.	Darling's Animal Fertilizer.
	" Extra Phosphate.
	" Pure Fine Bone.
Dickenson, D. B., Middle Haddam, Conn.	Ammoniated Bone Phosphate.
Kelsey, E. R., Branford, Conn.	Fish and Potash.
Lister Agricultural Chemical Works, Newark, N. J.	Potato Fertilizer.
	Standard Phosphate.
	Ammoniated Dissolved Bone.
	Ground Bone.
Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	Mapes' Potato Manure.
	" Corn "
	" Complete Manure for light soil.
	" " " A Brand.
	" " " for general use.
	" Fine Bone Dissolved.
	" Ground Bone.
	" Tobacco Manure, Conn. Brand.
	" " " for use with stems.
	" Grass and Grain Spring Top Dressing.
	Mapes' Peruvian Guano.
Meyer, C., Jr., Maspeth, L. I.	Acme Fertilizer, No. 1.
	" " No. 2.
Miles, G. W., Agent, Milford, Conn.	Fish and Potash, Fish Brand.
	I. X. L. Ammoniated Bone Superphosphate.
Miller, G. W., Middlefield, Conn.	Flour of Bone Phosphate.
	Pure Ground Bone.
Mitchell, A., Tremley, N. J.	Standard Phosphate.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizer.
	" Ammoniated Bone Phosph.
	" Fish and Potash.
	" Ground Bone.
Newton & Ludlam, 182 Front St., N. Y.	Cereal Fertilizer.
	Cecrops or Dragon's Tooth Fertilizer.
Orient Guano Manufacturing Co., Orient, L. I.	Orient Complete Manure.
	Fish and Potash.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Prentice, Charles, Putnam, Conn.	Potato Phosphate.
	Phosphate.
	Ground Bone.
Preston Fertilizer Co., Green Point, L. I.	Ammoniated Bone Superphosphate.
	Ground Bone.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate.
	Pine Island Ammoniated Phosphate.
	Fish and Potash, Crossed Fishes Brand.
	" " " Plain Brand.
	Dry Ground Fish.
	Bone Meal.
	Potato Manure.
	Muriate of Potash.

Firm.	*Brand of Fertilizers.*
Rogers & Hubbard Co., Middletown, Ct.	Raw Knuckle Bone Flour.
	Ground Bone, Grade AX.
	Fairchild's Formula, Bone and Potash.
	Fairchild's Formula for Corn and Wheat.
Ruth, R. J. & Co., 88 Wall St, N. Y.	Good Luck Guano.
Sanderson, L., 113 Long Wharf, New Haven, Conn.	Sulphate of Ammonia.
	Dried Blood.
	Dissolved Bone Black.
	Ground Bone.
	Kainit.
	Muriate of Potash.
	Sulphate of Potash.
	Nitrate of Soda.
	Tankage.
Shoemaker, M. L. & Co., Philadelphia, by F. Ellsworth, Hartford, Conn.	Swift Sure Superphosphate.
	" " Bone Meal.
Soluble Pacific Guano Co., Gildden & Curtis, agents, Boston, Mass.	Soluble Pacific Guano.
	Fish and Potash.
Standard Fertilizer Co., 30 Kilby Street, Boston, Mass.	Standard Superphosphate.
St. Louis Lead & Oil Co., St. Louis, Mo., by Olds & Whipple, Hartford, Conn.	St. Louis Lead & Oil Co.'s Castor Pomace.
Wilkinson & Co., 239 Center St., N. Y.	Wilkinson's Economical Bone Fertilizer.
	" Ammoniated Superphosphate.
Williams & Clark Co., Hanover Square, New York.	Americus Bone Superphosphate.
	" Potato Fertilizer.
	" Bone Meal.
	" Tobacco and Onion Fertilizer.
	Royal Bone Phosphate.
	Fish and Potash.

ANALYSES OF FERTILIZERS.*

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that will work against the public good.

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* The matter of this and several subsequent pages, explanatory of the, sampling and valuation of fertilizers, is copied, with a few appropriate alterations, from the Report for 1886. This repetition appears to be necessary for the use of readers who have not seen former Reports.

During 1887, two hundred and ninety (290) samples of fertilizers have been analyzed. Of these, a small number were examined for private parties and for testing methods in connection with other Experiment Stations, and the remainder for the general use of the citizens of the State.

During April and a part of May last, Messrs. E. C. Ellwood, of Green's Farms, and C. L. Gold, of West Cornwall, were employed as agents of the Station to collect fertilizer samples for analysis.

These gentlemen discharged their duties most satisfactorily as the following statement will show. One hundred and one towns or villages were visited:

In Litchfield County	16
Hartford "	15
Tolland "	9
Windham "	3
New London "	21
Middlesex "	2
New Haven "	10
Fairfield "	25
	101

About 560 samples of commercial fertilizers were drawn from lots which amounted in the aggregate to over 2700 tons. One or more samples were obtained of nearly every brand of goods sold in Connecticut.

When several samples of a single brand were collected the analysis was in most cases made on a mixture of equal quantities of each sample. A single analysis of such a mixture represents more nearly the average composition of a given brand than an analysis made on one sample or on a number of samples from one locality.

Besides the samples drawn by these special agents a considerable number have been taken by the Station chemists, 19 samples have been analyzed which were drawn by private persons and of these 13 were commercial fertilizers whose sale is regulated by the fertilizer law.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one, by means of a sampling tube, which withdraws a section or core through the entire length of the package.

The greatest care is necessary in sampling fertilizers that the small sample taken shall accurately represent the whole stock from which it is drawn. Otherwise serious injustice may be done.

The Station desires the coöperation of farmers, farmers' clubs and granges in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All samples drawn by other than Station agents are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

GRATUITOUS ANALYSIS OF COMMERCIAL FERTILIZERS.

To insure justice to manufacturers, dealers and consumers alike, the Station will make gratuitous analyses of Commercial Fertilizers only on samples taken by the Agents of the Station or on such other samples as are fully described on the Station Forms for Description and taken in accordance with the Station Instructions for sampling and furthermore are properly authenticated by the certificate of the person drawing the sample *and in addition* the witness, either

1. Of a Selectman;
2. Of an Officer of a farmer's club, grange or local agricultural society; or
3. Of the Dealer from whose stock the sample is taken.

In case a Dealer takes samples of his own stock, the witness of one of the Officers aforesaid will be required.

In special cases of importance the Station may send its Agent to draw samples.

INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

1. Provide a teacup, some large papers and for each sample a glass fruit can or tin box holding about one quart that can be tightly closed, all to be clean and dry.

2. Open at least three full and unbroken packages, or if there are more than thirty, every tenth package, and mix well together the contents of each for a foot in depth, take out two cupfuls from different parts of the mixed portions of each package, pour them [six in all] one over another upon a paper, intermix thoroughly but quickly to avoid gain or loss of moisture, fill the can or box from this mixture, close tightly, fix securely on the outside of the can a label with some distinguishing letter or mark (which is to be copied in the "Description of Sample" as *sampler's mark*), and

send prepaid to the Agricultural Experiment Station, New Haven, Conn.

3. If convenient weigh separately at least three packages and enter these *actual weights* in the "Description of Sample."

4. When a sample has been taken it should *always* be bottled, labeled and the form for its description filled out completely *before* beginning to sample another fertilizer.

Further Remarks on Sampling.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin tube, like a dipper handle, put well down into the packages in several places, will give a fair sample with great ease.

With dry, coarse articles, such as ground bone, there is liable to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions befor sampling.

The quantity sent should not be too small. When the material is fine and uniform, a pint is enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the sample should not be *less than one quart.*

It is important that samples for analysis should be taken at the time when the fertilizer is purchased, and *immediately dispatched* to the Station. Moist fish, blood or cotton seed meal will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much organic nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

Samples as to whose authenticity or fairly representative character there is any reasonable doubt, the Station will not analyze. The Station reserves the right to reject samples taken from less than half a ton of stock or those drawn from goods that have been wintered over from last year.

Send with each sample any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

Description of Sample.

Station No......... Rec'd at Station,...................., 188

Each sample of Commercial Fertilizer sent for gratuitous analysis *must* be accompanied by a Description made by filling out legibly and as fully as possible, the blanks that follow:

Sampler's Mark,..
Brand of Fertilizer,......................................
Name and address of Manufacturer,........................
....
Name and address of Dealer from whom this sample was taken,
....
Date of taking this sample,...............................
Is it stated to be fresh stock?...........................
Dealer's cash price per ton or hundred, bag or barrel,.........
Selling weight claimed for each package weighed,.............
Actual weight of the several packages opened.................
Number of packages from which the sample was taken,.........

Here write the per cents of valuable ingredients which the fertilizer is guaranteed to contain.

Soluble Phosphoric Acid,..................Nitrogen,...........
Reverted Phosphoric Acid, ...(Ammonia,..........)
(Available Phosphoric Acid,.................) Potash, ...
Insoluble Phosphoric Acid,.....................................

Certificate of Person taking the Sample.

I, the undersigned, certify that the accompanying sample marked.......was taken by me from full packages, and in accordance with the Station's Instructions for Sampling and to the best of my knowledge and belief fairly represents the stock from which it was drawn, and that said stock when sampled was properly housed and in good condition. I also certify that the foregoing description is correct.

Signature ....
Post Office address..................................

Witness of Officer or Dealer.

The above described sample was drawn in my presence.

Signature ....
Title ....
Township ....
Post Office Address.................................

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description" which accompanies it is filed in the Station's Record of Analyses, and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least, under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description," when properly filled out, also, contains all the data of cost, weight, etc., of a fertilizer which are necessary for making, with help of the analysis, a valuation of its fertilizing elements, and estimating the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the description may work injustice to the manufacturers or dealers, as well as mislead consumers. It is especially important that the *brand* of a fertilizer and its *selling price* shall be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated, and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for explanation or protest, if desirable, before the results are published in the Bulletin.

With the analysis there is sent to the party furnishing the sample a printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages, and are, therefore, reproduced here, as follows:

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

REVISED.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *Phosphoric acid* means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and reverted phosphoric acid are on the whole about equally valuable as plant-food and of nearly equal commercial value. In some cases, indeed, the soluble gives better results on crops, in others the reverted is superior. In most instances there is probably little to choose between them.

Insoluble Phosphoric acid implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada Apatite. Bone black, bone-ash, South Carolina Rock and Navassa Phosphate when in coarse powder are commonly of little repute as fertilizers though good results are occasionally reported from their use. When *very finely pulverized* ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones, which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It should be soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this Station, signifies finding *the worth in money or trade-value, of its fertilizing ingredients.* This value, it should be remembered, is *not necessarily proportional to its fertilizing effects* in any special case.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $60 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade Value of the above-named Ingredients*, a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

The average Trade-values or retail cost in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the New England, New York and New Jersey markets, are as follows :—

These Trade-values were agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several States during 1887.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1887.

	Cents per lb.
Nitrogen in ammonia salts	17½
" " nitrates	16
Organic nitrogen in dried and fine ground fish	17½
" " azotin, ammonite and dry ground meat	17½
" " castor pomace	17½
" " dried and fine ground blood	16½
" " fine ground bone and tankage	16
" " fine-medium bone and tankage	14
" " medium bone and tankage	12
" " coarse-medium bone and tankage	10
" " coarse bone and tankage, horn shavings, hair and fish scrap	8
Phosphoric acid, soluble in water	8
" " soluble in ammonium citrate*	7½
" " in dry ground fish	7
" " in fine bone and tankage	7
" " in fine-medium bone and tankage	6
" " in medium bone and tankage	5
" " in coarse medium bone and tankage	4
" " in coarse bone and tankage	3
" " in fine ground rock phosphate	2
Potash as high grade sulphate and in forms free from muriate (or chlorides)	5½
" as kainit	4½
" as muriate	4½

The above trade-values are the figures at which on March 1st, the respective ingredients could be bought at retail for cash, in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the *reasonable retail price* in case of standard raw materials such as:—

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* Dissolved from 2 grams of the unground phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Plain Superphosphate.
Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bone,
Ground So. Car. Rock.

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The Organic Nitrogen in these classes of goods is reckoned at the highest figure laid down in the Trade-Values of Fertilizing Ingredients in Raw Materials, namely 17½ cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, tankage, blood, fish, castor pomace or other equally good forms and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric Acid is reckoned at 3 cents, it being assumed, unless found otherwise, that it is from bone or similar source and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned as sulphate at 5½ cents.

In most cases the valuation of the Ingredients in Superphosphates and Specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally, profits. The majority of manufacturers agree that the average cost of mixing, bagging, handling and cartage ranges from $3.00 to $4.50 per ton.

In 1887 the average selling price of Ammoniated Superphosphates and Guanos was $35.74, the average valuation was $28.45 and the difference $7.29, an advance of 25.6 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of Specials the average cost was $42.52, the average valuation $35.20, and the difference $7.32 or about 20.9 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuaations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

CLASSIFICATION OF FERTILIZERS ANALYZED.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 1st, 1886, to Nov. 1st, 1887, were as follows :

Phosphate rock	2
Thomas-Slag	1
Superphosphates (plain)	14
Superphosphates (nitrogenous) and guanos	16
Home-mixed Superphosphates and other fertilizers	11
Special Manures	28
Bone Manures	26
Bone and Potash	2
Tankage and Animal Dust	16
Dried Blood	6
Tallow Scrap	1
Castor Pomace	3
Nitrate of Soda	4
Sulphate of Ammonia	3
Sulphate of Potash	7
Muriate of Potash	13
Kainit	6
Cotton Hull Ashes	10
Plaster	1
Wood Ashes	6
Waste Lye from Soap Works	1

Lime Kiln Ashes	1
Corn Cob Ashes	1
Coal Ashes	1
Tobacco Stalks	1
"Muck"	2
Salt Marsh Mud and Soil	8
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A number of these samples were analyzed in connection with other Experiment Stations for the purpose of testing methods and comparing results, and for private persons. The remaining analyses are given in detail so far as they have any general interest, with such discussion as may make them more serviceable. In all cases the samples were drawn by agents of the Station unless the contrary is stated.

THOMAS-SLAG.

2150. This by-product of the manufacture of steel from ores containing phosphorus is a fine powder which easily passes a $\frac{1}{10}$ inch sieve. A sample drawn from stock of J. H. Ives, Danbury, bought by him for experiment, had the following composition:

Phosphoric acid soluble in water	none
" " soluble in ammonium citrate	6.29
" " insoluble in ammonium citrate	13.19
Total phosphoric acid	19.48

This more nearly represents the average composition of the goods than the analysis of another sample given in last year's report. For results of the use of Thomas-Slag as a fertilizer on Indian corn see page 122.

PLAIN SUPERPHOSPHATES.

These are superphosphates which do not contain notable quantities either of potash or nitrogen. They are prepared from phosphatic materials of various kinds by treatment with oil of vitriol, [sulphuric acid], which renders a large proportion of the phosphoric acid soluble in water. Most superphosphates sold in this State are made from bone, bone black, South Carolina phosphate rock or Navassa phosphate. They are usually sold with a guarantee of the percentage of "available" phosphoric acid. This is a trade name for the phosphoric acid which is soluble either in water or in a neutral solution of ammonium citrate. See foot note, page 27.

1942. Dissolved Bone Black. Made by C. Meyer, Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

1893. Dissolved Bone Black. Stock of L. Sanderson, New Haven.

2005. Dissolved Bone Black. Made by C. M. Beach, West Hartford, and used in home mixtures.

1941. Pure Dissolved Bone. Sold by H. J. Baker & Bro., N. Y. Stock of Dennis Fenn, Milford.

2143. "Dissolved Bones." Made by H. Preston & Son, Greenpoint, Long Island. Stock of J. B. Merrow & Son, Merrow Station.

2142. "Plain Dissolved Bone." Made by Williams, Clark & Co., New York. Stock of A. P. Smith & Son, Lebanon.

2006. Dissolved South Carolina Rock. Bought of G. H. Nichols & Co., N. Y., by C. M. Beach, West Hartford, and used in home mixtures.

ANALYSES.

	1942	1893	2005	1941	2143[*]	2142	2006
Soluble Phosphoric Acid	13.62	15.55	9.05	17.35	4.36	10.88	13.15
Reverted Phosphoric Acid	2.55	.10	4.99	.17	10.21	2.28	.36
Insoluble Phosphoric Acid	.25	.18	3.74	.11	6.25	1.14	1.89
Cost per ton	$31.00[†]	26.00	24.00	26.00	32.00	25.00	16.40[‡]

No. **2005** was made by the following formula:

1000 lbs. bone black.
400 " oil of vitriol, 66° B.
400 " water.

The bone black cost $22.00 per ton in New York, the oil of vitriol cost $1.25 per 100 lbs., and the total cost per ton of the superphosphate is reckoned at $24.00. Only in exceptional cases will it pay to buy bone black and dissolve it on the farm. The experiment in this case seems to have been successful. A larger proportion of acid would have more completely decomposed the bone black.

In general the cost of soluble phosphoric acid in bone black superphosphate has been somewhat higher than that adopted by the Station for the valuation of mixed fertilizers:—thus the actual costs of soluble, reverted and insoluble phosphoric acid in the three samples of bone black superphosphate, Nos. **1942, 1893** and **1941** were, for soluble phosphoric acid, 8.5 cents per pound, for reverted phosphoric acid, 8 cents and for insoluble phosphoric acid, 2.1 cents; but the Station valuation for phosphoric acid is high when applied to superphosphates made from South Carolina rock which is the base most commonly used. The actual costs in No. **2006** were: for soluble phosphoric acid, 5.9 cents per pound, for reverted, 5.5 cents, and for insoluble, 1.5 cents.

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[*] This sample also contained .67 per cent of nitrogen.

[†] In Milford.

[‡] At the Farm.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included all mixed fertilizers containing nitrogen, phosphoric acid, and in most cases, potash, which are not designed by their manufacturers for use on any special crops. "Special Manures" are noticed further on. Fish scrap is classified with these goods because it is sometimes acidulated with oil of vitriol to preserve it, thus making it a nitrogenous superphosphate.

I. SAMPLES DRAWN BY STATION AGENTS.

In the tables on pages 38–49 are given sixty-six analyses of this kind. After the name of a brand of goods the names of a number of dealers are frequently given. This indicates that a sample of the goods was drawn by our agent from each dealer named and that the corresponding analysis was made on a mixture of equal parts of each of these samples.

The Station assumes full responsibility for accuracy of sampling and analysis only on such samples as are drawn by its own agents. On samples drawn by other persons the Station holds itself responsible only for the accuracy of analysis, but requires before making an analysis a formal statement that the person who drew the sample did it in accordance with the Station directions. See page 21.

Early in the year a circular was sent to all manufacturers whose goods were sold in Connecticut, asking them to inform the Station what would be about the average cash price of their goods in this State during the coming season. Replies were received from most of them. In the tables with the various *dealers'* quotations is also given for comparison the *manufacturers'* statement of the average retail cash price per ton in the State. The cash prices are usually about five per cent. lower than the credit or "time" prices.

The retail cash price of the same fertilizer as quoted by different dealers varies in some cases considerably, partly on account of differences in freight-rates, presence or absence of competition, etc.

The last column of the table of analysis is "Percentage Difference between Cost and Valuation." Its significance and the method of calculating it may be seen by noticing the fourth analysis in the table on page 46, No. **2046.** Here the cost is $28, the valuation is $26.65, and the difference between them is $1.35. By multiplying this difference, $1.35, by 100, and dividing it by the valuation, $26.65, we get the percentage advance of selling price over valuation, which advance should represent the costs and profits of the manufacturer in converting the raw materials into a mixed fertilizer, selling it and collecting on his sales.

Certain brands of superphosphates on which analysis fees have been paid as required by law are not included in the tables for they were not found by our agents in any of the places visited by them.

In case the manufacturers of these brands sent samples, this year, in compliance with the law, such samples have been analyzed and tabulated on page 51 as "Manufacturers' Samples."

1. *Special Notice of Certain Analyses.*

2119. Victor Phosphate. This brand is made for the Apothecaries Hall Co. by a fertilizer company outside of this State. In May last a Station Agent drew a sample from six bags of this brand in stock of Apothecaries Hall Co., Waterbury. Its analysis is given below, No. **2017.** The analysis was a disappointment to the Apothecaries Hall Co., who protested to the manufacturer. The manufacturer insisted that the analysis was wrong because he knew what was in the goods! At the request of the Apothecaries Hall Co., another agent was sent June 7 who drew from 18 packages the sample numbered **2069** whose analysis is given below.

The manufacturer still objected and the Station then proposed to send an agent to meet an agent of the manufacturer and that they together should sample the goods and divide the sample. This was done August 10th and a sample was taken from every tenth bag in the stock; these samples were mixed and the lot divided. The analysis is No. **2113.**

These three analyses which illustrate the degree of accuracy obtainable in sampling have been averaged and the average is given in the table No. **2119,** page 47. Because of the lower grade of the goods the Apothecaries Hall Co. have reduced the price below what it was in 1886.

	2017	**2069**	**2113**
Nitrogen	1.04	1.02	1.15
Soluble Phosphoric Acid	6.94	7.25	6.93
Reverted Phosphoric Acid	1.90	1.47	1.79
Insoluble Phosphoric Acid	1.14	1.33	1.17
Total Phosphoric Acid	9.98	10.05	9.89
Potash	2.41	2.58	2.09
Chlorine	2.64	2.52	2.39
Valuation per ton	$20.32	20.37	20.51

The tables contain two analyses each, of G. W. Miles' Fish and Potash, **2042** and **2095**, and of his IXL superphosphate **2039** and **2088**.

The earlier analysis of each was objected to by the manufacturer as misrepresenting the goods and the stock subsequently analyzed was stated to be of representative quality. There is, however, but little difference in quality in either case between the two samples.

There are also two analyses of Russell Coe's superphosphate **2033** and **2115** both from stock of Wilson and Burr, Middletown. It was claimed that the first sample, drawn April 14, misrepresented the goods and therefore another sample **2115** was drawn in August which had a very different composition and higher valuation. It represented, however, a different lot of goods which were received from the manufacturer later in the season.

Two analyses of the Economical Bone Fertilizer **1997** and **2016** illustrate the varying quality of this brand. In one case the percentage difference between cost and valuation is 48 per cent., in the other 68 per cent.

The dealer's cash price for Acme Fertilizer No. 2, No. **2038**, page 39, should be $45 instead of $47.

The manufacturer of Acme Fertilizer No. 1, Nos. **2111** and **2037**, page 47, calls attention to the fact that analysis No. **2037**, which was made on a sample drawn from a single ton of stock, does not represent the general character of the goods, being lower in potash and higher in nitrogen than the goods average.

With the nitrogenous superphosphates should be classed **2029** Bowker's Dry Ground Fish. In this brand only nitrogen is guaranteed. The analysis was made on a mixture of two samples, one from T. Pease and Sons Co., Windsor Locks, cost $40, the other from H. K. Brainard, Thompsonville, cost $38. The mixture contained 8.31 per cent. of nitrogen, guaranteed 8.0.

Fish and Potash.—This brand has been for a long time a popular one in this state and for ready comparison the different brands are tabulated by themselves on page 37.

Their average cost is $31.86, valuation $25.25 and per cent. difference between cost and valuation, 26.1, about the same as that of other nitrogenous superphosphates. Most of them are not, as the name properly implies, simple mixtures of fish scrap and potash salts, but contain considerable quantities of added phosphates. In three cases a large proportion of the phosphoric acid is insoluble.

2. *Difference between Cost and Valuation.*

Leaving out the last three analyses in the tables, whose percentage difference is over 50 per cent., the average cost of 63 superphosphates has been $35.74, the average valuation $28.45. The difference is $7.29, and the percentage difference 25.62. This means that the same quantities of nitrogen, phosphoric acid and potash, which were contained in a ton of the average superphosphate, could be bought in ton lots in this State for $28.45 cash, that the price asked for them in mixed goods was $35.74 and hence that mixing, bagging, selling and profits required an addition of 25.62 per cent. to the cost of the materials themselves.

3. *Guarantees.*

In nineteen brands the percentage of one ingredient was more than two-tenths per cent. below the minimum guarantee and in four brands two ingredients were thus deficient.

In most cases the deficit was on potash and came about by an inaccurate (and in this State illegal) method of stating the guarantee. The law provides that the guarantee shall be "expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station." The terms and manner of statement have been clearly set forth in the reports of this Station from the time the law went into force. The amount of *actual potash* must be stated. If desired, the equivalent of sulphate of potash may also be given. The phrase "Potash [sulphate] 4.0 per cent." correctly understood, means 4.0 per cent. of actual potash in the form of sulphate and not 4.0 per cent. of sulphate of potash which contains but little more than half its weight of actual potash.

FISH AND POTASH.—SAMPLED BY THE STATION.

	Quinnipiac Plain Brand.	Kelsey's.	Bradley's Triangle A.	Bowker's.	Miles'.	Pacific Guano Co's.	Quinnipiac, Crossed Fishes Brand.	Chittenden's.	Miles'.	Orient.	E. F. Coe's.
	2064	**1957**	**2052**	**2028**	**2095**	**2047**	**1999**	**2022**	**2042**	**2075**	**2053**
Nitrogen as Ammonia	.65	----	.69	----	.32	.37	.65	.21	----	.44	----
Nitrogen, Organic	3.15	3.78	3.09	2.54	2.27	1.97	3.46	3.32	2.23	2.99	2.36
Soluble Phosphoric Acid	1.01	1.17	2.80	1.86	6.44	4.89	.91	.65	7.56	3.24	3.02
Reverted Phosphoric Acid	4.33	1.77	3.34	2.92	.68	3.22	4.73	5.02	.67	.90	2.86
Insoluble Phosphoric Acid	1.86	.24	2.53	7.96	.28	1.39	1.75	3.29	.28	.32	2.65
Potash	4.83	3.32	3.99	4.19	4.53	4.92	5.02	4.82	3.51	9.11	3.60
Cost	$28.00	$22.00	$33.00	$30.00	$30.00	$32.50	$36.00	$34.50	$32.00	$37.50	$35.00
Valuation	$26.65	$20.72	$27.63	$24.59	$24.41	$25.85	$28.27	$27.00	$24.14	$26.47	$22.03
Nitrogen found	3.80	3.78	3.78	2.54	2.59	2.34	4.11	3.53	2.23	3.43	2.36
Nitrogen guaranteed	2.00	2.50	2.00	2.30	2.50	2.50	3.30	3.30	2.50	3.00	3.30
Phosphoric Acid found	7.20	3.18	8.67	12.74	7.40	9.50	7.39	8.96	8.51	4.46	8.53
Phosphoric Acid guaranteed	6.00	3.00	6.00	8.00	----	6.00	5.00	6.00	----	----	----
Potash found	4.83	3.32	3.99	4.19	4.53	4.92	5.02	4.82	3.51	9.11	3.60
Potash guaranteed	4.00	3.00	4.00	4.00	*3.00	4.00	3.00	5.00	*3.00	*14.00	*4.00

* As Sulphate.

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2010	Quinnipiac Dry Ground Fish.	Quinnipiac Co., New London, Ct.	R. B. Bradley & Co., New Haven.	----	$37.00
			Olds & Whipple, Hartford,	$37.00	
			D. C. Wood, Stratford.	38.00	
1912	Fish Scrap.		L. Sanderson, Long Wharf, New Haven.	35.00	35.00
1918	Swift Sure Superphosphate.	M. L. Shoemaker & Co., Phila.	F. Ellsworth, Hartford.	38.00	38.00
2046	Fish and Potash, Plain Brand.	Quinnipiac Co., New London, Ct.	Wilson & Burr, Middletown.	28.00	28.00
			P. & G. M. Williams, New London.	26.00	
			R. B. Bradley & Co., New Haven.	----	
1957	Kelsey's Fish and Potash.	E. R. Kelsey, Branford, Conn.	M. S. Baldwin, Meriden.	22.00	....
2079	Pure Fine Bone Dissolved in Sulphuric Acid.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	35.00	35.00
			Strong & Backus, Colchester.	36.00	
2065	Peruvian Guano, Cargo Jonas.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	Mapes' Branch, Hartford.	47.00	47.00
1969	Quinnipiac Phosphate.	Quinnipiac Co., New London, Ct.	R. B. Bradley & Co., New Haven.	----	36.00
			E. A. Godfrey, Southport.	36.00	
			D. B. Mansfield, Campville.	36.00	
			J. F. Silliman, New Canaan.	38.00	
			R. N. Birchard, Darien.	38.00	
1965	A. A. Ammoniated Superphosphate.	H. J. Baker & Bro., 215 Pearl St., New York.	R. B. Bradley & Co., New Haven.	----	37.00
			C. O. Jelliff & Co., Southport.	37.50	
			Dennis Fenn, Milford.	37.50	
			Allen Betts, Norwalk.	37.00	
			S. J. Hall, Meriden.	37.50	
2025	Standard Superphosphate of Lime.	Lister Fertilizer and Chemical Works, Newark, N. J.	E. A. Brock & Co., Willimantic.	----	35.00
			J. O. Fox & Co., Putnam.	35.00	
			S. J. Hall, Meriden.	31.00	
			A. N. Clark, Milford.	32.00	
			Martin Bros., Wallingford.	32.00	

NITROGENOUS SUPERPOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
1988	Farmer's New Method Fertilizer.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	$34.00	$34.00
			Strong & Tanner, Winsted.	34.20	
			D. N. Clark & Sons, Milford.	34.00	
			Beach & Son, New Milford.	35.00	
			J. L. Butler, Torrington.	....	
2038	Acme Fertilizer, No. 2.	C. Meyer, Jr., Maspeth, L. I.	A. S. Russell & Co., Meriden.	47.60	45.00
			J. H. Ives, Danbury.	45.00	
2052	Fish and Potash, Triangle A Brand.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	A. H. Dimond, Bethel.	33.00	....
2045	Pine Island Phosphate.	Quinnipiac Co., New London, Conn.	H. J. Standift, New Hartford.	30.00	32.00
			D. C. Wood, Stratford.	30.00	
2011	Mapes' Complete Manure for General Use.	Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y.	R. B. Bradley & Co., New Haven.	....	41.00
			Mapes' Branch, Hartford.	41.00	
			Birdsey & Foster, Meriden.	42.50	
			Southington Lumber and Feed Co., Southington.	41.50	
			J. O. Fox & Co., Putnam.	41.00	
			Dunham & Co., Cheshire.	42.00	
			Dean & Horton, Stamford.	42.00	
1971	Americus Brand, Ammoniated Bone Superphosphate.	Williams & Clark Co., Hanover Square, New York.	J. F. Silliman, New Canaan.	38.00	36.00
			Atwood & Wilson, Watertown.	36.00	
			E. M. Jennings, Southport.	35.00	
			R. B. Bradley & Co., New Haven.	....	
			Soule & Staub, New Milford.	38.00	
2108	Chittenden's Ammoniated Bone Superphosphate.	National Fertilizer Co., Bridgeport, Conn.	G. W. Eaton, Plainville.	34.00	....
			W. W. Cooper, Suffield,	34.00	
			L. N. Currier, Bridgeport.	35.00	

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2028	Fish and Potash.	**Bowker Fertilizer Co., 43 Chatham Street, Boston, Mass.**	T. Pease & Sons Co., Windsor Locks.	$33 00	$30.00
			H. K. Brainard, Thompsonville.	30.00	
			Dunham & Co., Cheshire.	33.00	
2111	Acme Fertilizer, No. 1.	**C. Meyer, Jr., Maspeth, Long Island.**	A. S. Russell & Co., Meriden.	45.00	45.00
1972	**Extra Fine Ground Bone with Potash, Circle Brand.**	**Bradley Fertilizer Co, 27 Kilby Street, Boston, Mass.**	Lockwood Bros., Watertown.	32.00	32.00
			Charles Jennings & Son, Southport.	33.00	
			J. L. Butler, Torrington.	35.00*	
2095	Fish and Potash.	**G. W. Miles, Agent for John Guyer, Milford, Conn.**	John Guyer, New Haven.	30.00	30.00
1985	High Grade Ammoniated Bone Phosphate.	**E. F. Coe, 16 Burling Slip, New York.**	Manufacturer.†	35.00	35.–38.00
2037	Acme Fertilizer, No. 1.	**C. Meyer, Jr., Maspeth, L. I.**	J. H. Ives, Danbury.	45.00	45.00
2008	Mapes' Complete Manure for Light Soil.	**Mapes' Formula & Peruvian Guano Co., 158 Front Street, New York.**	Dean & Horton, Stamford.	46.00	45.00
			R. B. Bradley & Co., New Haven.	45.00	
			Birdsey & Foster, Meriden.	46.50	
			D. B. Beadsley, Southport.	45.00	
			Wilson & Burr, Middletown.	45.00	
			Mapes' Branch, Hartford.	45.00	
1968	Chittenden's Complete Manure.	**National Fertilizer Co., Bridgeport, Conn.**	Allen Betts, Norwalk.	43.00	....
			W. W. Cooper, Suffield.	45.00	
			L. N. Currier, Bridgeport.	45.00	
2034	Darling's Animal Fertilizer.	**L. B. Darling & Co., Pawtucket, R. I.**	J. M. Belden, New Britain.	40.00	38.00
			Dunham & Co., Cheshire.	37.50	
			E. F. Davis, Plainville.	38.00	
			Olds & Whipple, Hartford.	40.00	
			J. W. Cutler, Putnam.	38 00	
			L. A. Hall, South Coventry.	38.00	
			N. O. Barker & Co., Lebanon.	38.00	

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* Sold in small lots.

† Sampled from a lot bought by a number of farmers in Middlefield.

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2023	Bay State Fertilizer.	Clark's Cove Guano Co., New Bedford, Mass.	J. B. Carman, South Coventry.	$38.00	----
			R. H. Hall, East Hampton.	38.00	
			E. C. Dennis, Stafford.	38.00	
			J. H. Ives, Danbury.	40.00	
			A. L. Chamberlain, Fair Haven.	36.00	
2047	Fish and Potash.	Soluble Pacific Guano Co., Boston, Mass.	W. H. Tucker, Lebanon.	32.00	----
			B. Curtis & Son, Stepney Depot.	33.00	
1999	Fish and Potash, Crossed Fishes Brand.	Quinnipiac Co., New London, Conn.	J. F. Silliman, New Canaan.	38.00	$35.00
			S. N. Osborn, Easton.	38.00	
			Wilson & Burr, Middletown.	35.00	
			D. B. Mansfield, Campville.	36.00	
			R. B. Bradley & Co., New Haven.	35.00	
			Olds & Whipple, Hartford.	37.00	
1966	High Grade Ammoniated Bone Superphosphate.	E. F. Coe, 16 Burling Slip, New York.	Wheeler & Howes, Bridgeport.	35.00	35.–38.00
			Simon Banks, Southport.	34.00	
			Allen Betts, Norwalk.	33.00	
			Walker & Nutting, Waterbury.	38.00	
2022	Chittenden's Fish and Potash.	National Fertilizer Co., Bridgeport, Conn.	W. W. Cooper, Suffield.	35.00	----
			G. W. Eaton, Plainville.	34.00	
			T. H. Eldredge, Norwich.	35.00	
			David Fitzgerald, Stratford.	33.25	
2119	Victor Phosphate.	Made for the Apothecaries Hall Co., Waterbury.	Apothecaries Hall Co., Waterbury.	26.00	----
2074	Darling's Extra Phosphate.	L. B. Darling Fertilizer Co., Pawtucket, R. I.	J. P. Barstow & Co., Norwich.	36 00	38.00
			Olds & Whipple, Hartford.	38.00	
2032	Unicorn Ammoniated Superphosphate.	Clark's Cove Guano Co., New Bedford, Mass.	A. L. Chamberlain, Fair Haven.	34.20	----

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2003	Ammoniated Bone Superphosphate.	Crocker Fertilizer and Chemical Works, Buffalo, N. Y.	J. M. Belden, New Britain.	$40.00	----
			J. H. Reay, Greenwich.	35.00	
			E. T. Morehouse, New Hartford.	40.00	
			Sherman Foote, Brookfield Centre.	35.00	
2018	Pelican Bone Fertilizer.	H. J. Baker & Bro., 215 Pearl St., New York.	Dennis Fenn, Milford.	32.50	$32.50
			Jas. Greenfield, New London.	32.50	
1975	Patent Superphosphate of Lime.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Beach & Son, New Milford.	38.00	37–38
			Peck Bros., Northfield.	38.00	
			Lockwood Bros., Watertown.	36.00	
			J. L. Butler, Torrington.	----	
			D. N. Clark & Sons, Milford.	37.00	
			O. A. Hubbell, Harwinton.	----	
			Wilson & Burr, Middletown.	38.00	
			Walker & Nutting, Waterbury.	38.00	
			Raymond Bros., Norwalk.	38.00	
			Strong & Tanner, Winsted.	38.00	
			A. A. Hubbard, Canaan.	38.00	
2009	Mapes' Complete Manure, A Brand.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Southington Lumber and Feed Co., Southington.	38.50	38.00
			Dunham & Co., Cheshire.	39.00	
			J. E. Dean, Winsted.	40.00	
			A. F. Roberts, Lakeville.	38.00	
			J. O. Fox & Co., Putnam.	40.00	
			Birdsey & Foster, Meriden.	39.50	
			Dean & Horton, Stamford.	40.00	
			Mapes' Branch, Hartford.	38.00	
			Wilson & Burr, Middletown.	38.00	
			R. B. Bradley & Co., New Haven	38.00	

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2019	Hill and Drill Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Dunham & Co., Cheshire.	$40.00	$36.00
			Brewster & Burnett, Norwich.	38.00	
			Southington Lumber and Feed Co., Southington.	37.50	
			R. S. Converse, Stafford.	38.00	
			Jas. Greenfield, New London.	37.50	
2020	Bowker Ammoniated Bone Phosphate.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Dunham & Co., Cheshire.	35.00	32.00
			Jas. Greenfield, New London.	35.00	
			Hubbell & Bradley, Saugatuck.	32.00	
			Brewster & Burnett, Norwich.	38.00	
2044	Ammoniated Bone Superphosphate.	Preston Fertilizer Co., Greenpoint, Brooklyn, L. I.	A. L. Hodges, Roxbury Station.	33.00	....
			J. B. Merrow & Sons, Merrow Station.	34.00	
2115	Ammoniated Superphosphate.	Russell Coe, Tremley, N. J.	Wilson & Burr, Middletown.	30.00	....
2042	Fish and Potash.	G. W. Miles, Milford.	Simon Banks, Southport.	32.00	
1974	Alkaline Bone.	E. Frank Coe., 16 Burling Slip, New York.	Wheeler & Howes, Bridgeport.	35.00	32–34
			J. F. Silliman, New Canaan.	32.00	
			Allen Betts, Norwalk.	29.00	
2014	Cumberland Superphosphate.	Cumberland Bone Co., Portland, Me.	C. P. Capron, Norwich Town.	38.00	38.00
			Brainard & Childs, New London.	40.00	
			J. W. Cutler, Putnam.	38.00	
2021	Original Coe's Superphosphate of Lime.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	36.00	34–35
2018	Improved Blood Guano.	Dambmann Bros. (Ed. F. Cook, Agt.), Baltimore, Md.	W. Dudley, Guilford.	35.00	30–35
			Champion & Caulkins, Lyme.	35.00	
2048	Royal Bone.	Williams & Clark Co., Hanover Square, New York City.	Hale, Day & Co., So. Manchester.	30.00	....
			L. W. Dart, Niantic.	30.00	
			Strong & Backus, Colchester.	29.00	
			A. P. Smith & Sons, Lebanon.	27.00	

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
1987	Standard Superphosphate.	Standard Fertilizer Co., 118½ Milk St., Boston, Mass.	Allen Wilson, Suffield.	$38.00	....
1977	Good Luck Guano.	R. J. Ruth & Co., New York.	H. J. Mattoon, Watertown.	36.00	....
			H. L. Hall, 2d, Wallingford.	36.00	
2081	Great Planet A. Manure.	Clark's Cove Guano Co., New Bedford.	J. H. Ives, Danbury	46.00	....
			A. L. Chamberlain & Co., Fair Haven.	45.60	
2067	Cecrops or Dragon Tooth Fertilizer.	Newton & Ludlam, 182 Front St., New York.	D. N. Benton, Guilford.	41.50	....
2024	Common Sense Fertilizer, No. 2.	Common Sense Fertilizer Co., 42 Congress St., Boston, Mass.	E. Fly, Putnam.	35.00	....
			W. H. Cardwell, Norwich.	35.00	
			Jas. Greenfield, New London.	35.00	
2066	Cereal Fertilizer.	Newton & Ludlam, 182 Front St., New York.	J. E. Littlefield, Niantic.	34.00	....
			D. N. Benton, Guilford.	31.50	
2088	I. X. L. Ammoniated Superphosphate.	G. W. Miles, Agent, Milford, Conn.	John Guyer, New Haven.	33.00	$33.00
1986	Red Brand Excelsior Guano.	E. Frank Coe, 16 Burling Slip, New York.	Manufacturer.*	45.00	45.00
2075	Fish and Potash.	Orient Guano Manufacturing Co., Orient, L. I.	J. E. Dean, Winsted.	37.50	....
2083	Ammoniated Bone Superphosphate.	Russell Coe, Tremley, N. J.	Wilson & Burr, Middletown.	30.00	....
2039	I. X. L. Ammoniated Bone Superphosphate.	G. W. Miles, Milford, Conn.	W. Sardam, Canaan.	36.00	....
			Platt & Merwin, Milford.	30.00	
			J. P. Barstow, Norwich.	32.00	

* Sampled from a lot bought by a number of farmers in Middlefield.

NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
1970	Soluble Pacific Guano.	Glidden & Curtis, Agents, Boston, Mass.	Wm. M. Perry & Co., Stratford.	38.00	....
			H. A. Stillman, Hartford.	38.00	
			A. A. Hubbard, Canaan.	38.00	
			Balch & Platt, W. Winsted.	38.00	
			Talcott & Alvord, Torrington.	37.00	
2043	Standard Superphosphate.	A. Mitchell, Tremley Pt., Staten Island.	Hull & Sweet, Coventry.	38.00	$36.00
2015	Orient Complete Manure.	Orient Guano Co., Orient, L. I.	J. E. Dean, Winsted.	30.00	....
			M. G. Morse, Guilford.	30.00	
			G. W. Eaton, Plainville.	33.00	
1997	Economical Bone Fertilizer.	Wilkinson & Co., 239 Center St., New York.	G. H. Loomis, Chestnut Hill.	35.00	....
2053	High Grade Fish Guano and Potash.	E. Frank Coe, 16 Burling Slip, New York.	Hall, Hornbeck & Co., Falls Village.	35.00	....
2016	Economical Bone Fertilizer.	Wilkinson & Co., 239 Center St., New York.	A. L. Anderson & Son, Tolland.	32.00	....
1996	Ammoniated Superphosphate.	Wilkinson & Co., 239 Center St., New York.	Ferris & Nolan, Stamford.	38.00	....

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
												Available.							
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
2010	Quinnipiac Dry Ground Fish	....	....	8.97	8.97	7.5	.80	5.50	.88	7.18	....	6.30	4.0	.. .	....	....	$37.00	$41.46	10.7†
1912	Sanderson's Fish Scrap	....	....	7.96	7.96	6.6	.98	3.95	1.35	6.28	6.0	4.93	....	....	....	....	35.00	36.16	3.2†
1918	Swift Sure Superphosphate	.74	....	2.45	3.19	2.5	9.06	3.45	2.27	14.78	....	12.51	9.0	4.79	4.0*	trace	38.00	37.25	2.0
2046	Fish and Potash, Plain Brand	....	.65	3.15	3.80	2.0	1.01	4.33	1.86	7.20	6.0	5.34	4.0	4.83	4.0	7.91	28.00	26.65	5.0
1957	Kelsey's Fish and Potash..	....	....	3.78	3.78	2.5	1.17	1.77	.24	3.18	3.0	2.94	....	3.32	3.0	2.94	22.00	20.72	6.1
2079	Mapes' Pure Fine Bone Dissolved in Sulphuric Acid.	....	....	1.89	1.89	2.1	5.76	10.88	.76	17.40	....	16.64	12.0	....	....	....	35.00	32.62	8.8
2065	Peruvian Guano, cargo Jonas	.11	2.13	1.05	3.29	3.9	4.23	9.90	8.19	22.32	22.9	14.13	....	5.01	2.6	2.25	47.00	42.77	9.8
1969	Quinnipiac Phosphate.....	.51	trace	2.73	3.24	2.7	7.24	4.37	1.83	13.44	....	11.61	9.0	2.61	2.0	2.61	36.00	32.65	10.2
1965	Baker's A. A. Ammoniated Superphosphate	....	2.87	.50	3.37	2.5	11.73	.44	.13	12.30	....	12.17	10.0	2.94	2.0	3.19	37.50‡	33.80	10.9
2025	Lister's Standard Superphosphate of Lime..........	....	1.20	.96	2.16	2.3	10.59	1.07	.70	12.36	....	11.66	10.0	1.63	1.5	1.17	32.50	27.92	16.4
1988	Farmer's New Method Fert'r	....	.14	2.29	2.43	1.7	8.36	1.68	2.56	12.60	10.0	10.04	8.0	3.32	3.0	3.02	34.00	28.77	18.2
2038	Acme Fertilizer, No. 2	....	4.94	.58	5.52	5.0	7.09	1.13	.21	8.43	8.5	8.22	8.0	6.35	5.0	4.99	45.00	37.89	18.8
2052	Fish and Potash, Triangle A Brand..............	....	.69	3.09	3.78	2.0	2.80	3.34	2.53	8.67	6.0	6.14	4.0	3.99	4.0	5.02	33.00	27.63	19.5
2015	Pine Island Phosphate.....	....	.45	1.98	2.43	2.0	5.78	4.25	1.31	11.34	....	10.03	9.0	1.94	1.0	2.99	32.00	26.57	20.4
2011	Mapes' Complete for General Use	.79	.91	1.92	3.62	3.3	5.44	4.12	3.78	13.34	10.0	9.56	....	4.87	4.0	3.21	41.00	33.88	21.0
1971	Americus Brand Ammoniated Bone Superphosp'ate	....	.79	1.87	2.66	2.0	9.20	1.71	.55	11.46	11.0	10.91	....	2.49	2.0	trace	36.00	29.67	21.3
2108	Chittenden's Ammoniated **Bone Superphosphate** ...	.08	....	2.48	2.56	1.7	7.22	3.18	1.57	11.97	9.0	10.40	7.0	1.99	2.0	2.52	34.00	27.89	21.9

* As Sulphate. † Valuation exceeds Cost. ‡ Manufacturer quotes $37, which would make the percentage difference 9.4.

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
2028	Bowker's Fish and Potash	....	....	2.54	2.54	2.3	1.86	2.92	7.96	12.74	8.0	4.78	....	4.19	4.0	3.83	$30.00	$24.59	22.0
2111	Acme Fertilizer, No. 1	....	3.25	1.12	4.37	3.7	7.72	.31	.05	8.08	....	8.03	8.0	10.12	9.0	9.03	45.00	36.75	22.4
1972	Extra Fine Ground Bone with Potash, Circle brand	....	....	2.04	2.04	1.9	3.00	5.16	5.42	13.58	8.0	8.16	....	3.74	2.0	5.99	32.00	26.11	22.5
2095	Miles' Fish and Potash	....	.32	2.27	2.59	2.5	6.44	.68	.28	7.40	....	7.12	5.0	4.53	3.0*	3.56	30.00	24.41	22.9
1985	High Grade Ammoniated Bone Phosphate	....	.95	1.37	2.32	2.1	9.12	1.75	1.18	12.05	11.0	10.87	9.0	2.17	3.0*	.22	35.00	28.36	23.4
2037	Acme Fertilizer, No. 1	....	3.98	.67	4.65	3.7	7.36	1.06	.23	8.65	....	8.42	8.0	7.67	9.0	5.14	45.00	36.31	23.9
2008	Mapes' Complete for Light Soils	1.37	2.59	1.41	5.37	5.0	2.97	3.20	3.31	9.48	7.0	6.17	....	7.50	6.0	6.62	45.00	36.30	23.9
1968	Chittenden's Complete Fertilizer	.30	.65	2.97	3.92	3.7	4.90	4.87	4.71	14.48	8.0	9.77	6.0	5.07	6.0	2.91	45.00	36.22	24.2
2034	Darling's Animal Fertilizer	.45	.37	2.83	3.65	3.3	2.68	4.65	3.63	10.96	10.0	7.33	....	5.19	4.0	5.54	38.00	30.50	24.6
2023	Bay State Fertilizer	....	.91	1.70	2.61	2.0	8.68	2.05	1.88	12.61	10.0	10.73	8.0	2.95	2.0	.76	38.00	30.22	25.7
2047	Pacific Guano Co's Fish and Potash	....	.37	1.97	2.34	2.5	4.89	3.22	1.39	9.50	6.0	8.11	4.0	4.92	4.0	8.69	32.50	25.85	25.7
1999	Fish and Potash, Crossed Fishes Brand	....	.65	3.46	4.11	3.3	.91	4.73	1.75	7.39	5.0	5.64	3.0	5.02	3.0	6.18	36.00	28.27	27.3
1966	E. F. Coe's Ammoniated Bone Superphosphate	....	.56	1.70	2.26	2.0	8.26	2.02	1.91	12.19	11.0	10.28	9.0	1.96	3.0*	trace	35.00	27.47	27.4
2022	Chittenden's Fish and Pot'sh	....	.21	3.32	3.53	3.3	.65	5.02	3.29	8.96	6.0	5.67	....	4.82	5.0	9.22	34.50	27.00	27.7
2119	Victor Phosphate	....	....	1.07	1.07	....	7.04	1.72	1.21	9.97	....	8.76	....	2.36	....	2.49	†26.00	20.33	27.8
2074	Darling's Extra Phosphate	.41	.57	1.85	2.83	2.5	6.23	3.47	1.60	11.30	10.0	9.70	7.0	3.33	3.0	3.19	37.00	28.75	28.7

* As Sulphate.

† See Explanatory note in this Bulletin.

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
2032	Unicorn Ammoniated Superphosphate	----	.05	2.18	2.23	2.1	6.32	3.15	2.67	12.14	10.0	9.47	8.5	2.56	2.3	1.70	$34.20	$26.49	29.1
2003	Crocker's Bone Superphosphate	----	trace	3.11	3.11	2.9	7.87	1.96	1.25	11.08	----	9.83	8.0	2.21	1.0*	2.16	37.50	29 05	29.1
2018	Pelican Bone Fertilizer	----	1.67	.69	2.36	1.9	8.60	.41	.11	9.12	----	9.01	8.0	2.88	2.0	2.29	32.50	25.16	29.2
1975	Bradley's Patent Superphosphate of Lime	.30	----	2.55	2.85	2.3	8.05	2.12	2.38	12.55	11.0	10.17	9.0	1.91	1.5	1.93	37 50	29.00	29.3
2009	Mapes' Complete Manure, A Brand	.78	.60	1.16	2.54	2.5	5.71	4.56	3.32	13.59	----	10.26	10.0	3.19	2.5	3.58	38.00	29.34	29.5
2019	Hill and Drill Phosphate	----	.23	2.33	2.56	2.5	8.45	2.23	3.19	13.87	12.0	10.68	----	1.75	2.0	2.52	38.00‡	29.23	30.0
2020	Bowker's Ammoniated Bone Phosphate	----	----	1.95	1.95	2.0	8.74	1.36	1.99	12.09	11.0	10.10	10.0	1.57	2.0	1.79	33.00§	25.36	30.1
2044	Preston's Bone Superphosphate	----	----	2.57	2.57	2.5	5.35	1.99	2.83	10.17	----	7.34	9.0	3.25	2.0	.73	33.50	25.58	30.9
2115	Russell Coe's Ammoniated Superphosphate	----	.70	1.07	1.77	2.0	6.75	2.51	.99	10.25	10.0	9.26	8.0	1.69	1.0	5.60	30.00	22.80	31.6
2042	Miles' Fish and Potash	----	----	2.23	2.23	2.5	7.56	.67	.28	8.51	----	8.23	5.0	3.51	3.0*	2.45	32.00	24.14	32.5
1974	E. Frank Coe's Alkaline Bone	----	----	1.22	1.22	1.0	7.30	2.74	2.90	12.94	----	10.04	9.0	2.04	3.0*	trace	32.00	24.04	33.1
2014	Cumberland Superphosphate	.63	.05	1.73	2.41	2.0	6.00	2.71	4.65	13.36	11.0	8.71	8.0	3.94	2.0	1.66	38.00	28.49	33.3
2021	Original Coe's Superphosphate of Lime	----	----	2.32	2.32	2.1	7.67	2.35	2.54	12.56	10.0	10.02	8.0	1.77	1.0	1.76	36.00†	26.93	33.7
2013	Improved Blood Guano	.66	.55	1.11	2.32	1.6	7.44	2.16	1.21	10.81	----	9.60	8.0	2.73	2.0	3.04	35.00	26.11	34.0
2018	Royal Bone	----	----	1.53	1.53	.3	6.33	2.12	.47	8.92	8.0	8.45	----	2.54	2.0	.36	29.00	21.63	34.0

* As Sulphate.

† Manufacturer quotes $34.00, which would make the percentage difference 28.1.

‡ Manufacturer quotes $36.00, which would make the percentage difference 23.1.

§ Manufacturer quotes $32.00, which would make the percentage difference 26.1.

ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1987	Standard Superphosphate	....	trace	2.78	2.78	2.5*	7.20	2.24	2 50	11.94	11.0	9.44	9.0	2.47	2.0	3.57	38.00	28.21	34.7
1977	Good Luck Guano	....	.51	1.68	2.19	2.5	8.19	1.86	1 24	11.29	....	10.05	10.0	2.16	2.0	1.64	36.00	26.14	37.7
2031	Great Planet A Manure	....	1.54	1.80	3.34	3.3	5.47	2.43	1.39	9.29	8.3	7.90	7.0	9.54	9.5	6.65	46.00	33.22	38.5
2067	Cecrops or Dragon Tooth Fertilizer	....	.90	1.81	2.71	3.3	7.52	1.52	2.77	11.81	....	9.04	7.0	5.28	7.0	5.24	41.50	29.95	38.5
2024	Common Sense Fertilizer, No. 2	....	2.61	.73	3.34	2.0	.21	5.54	3.30	9.05	4.0	5.75	....	3.08	3.0	3.24	35.00	24.94	40.3
2066	Cereal Fertilizer	....	....	1.40	1.40	1.5	7.83	2.01	2.52	12.36	12.0	9.84	10.0	1.59	4.0	2.11	32.75	23.31	40.5
2088	I. X. L. Ammoniated Superphosphate	....	.23	1 83	2.06	....	7.06	1.81	.62	9.49	....	8.87	....	2.13	....	2.99	33.00	23.41	40.9
1986	Red Brand Excelsior Guano	....	trace	3.27	3.27	3.3	7.40	1.80	1.17	10.37	10.0	9.20	....	4.88	11.0*	.52	45.00	31.89	41.1
2075	Orient Fish and Potash	....	.44	2.99	3.43	3.0	3.24	.90	.32	4.46	....	4.14	5.0	9.11	14.0*	8.48	37.50	26.47	41.6
2038	Russell Coe's Ammoniated Superphosphate	....	....	.97	.97	2.0	7.09	2.71	1.83	11.63	10.0	9.80	8.0	1.11	1.0	4.77	30.00	20.85	43.9
2039	I. X. L. Ammoniated Bone Superphosphate	....	....	1.58	1.58	2.1	6.98	2.33	1.15	10.46	....	9.31	8.0	1.48	1.0*	2.52	32.00	22.13	44.6
1970	Soluble Pacific Guano	....	....	2.22	2.22	2.0	6.82	2.21	3.40	12.43	....	9.03	8.0	2.52	2.0	2.61	38.00	26.18	45.1
2043	Mitchell's Superphosphate	....	....	1.99	1.99	2.1	8.30	2.49	45	11.24	11.5	10.79	9.0	1.81	3.0	trace	38.00	25.80	47.3
2015	Orient Complete Manure	....	.14	1.45	1.59	1.7	6.45	2.23	1.10	9.78	....	8.68	8.0	1.24	2.0*	1.47	31.00	20.95	47.9
1997	Economical Bone Fertilizer	....	1.59	.49	2.08	1.3	5.87	1.94	.57	8.38	6.00	7.81	....	4.32	2.0*	9.22	35.00	23.59	48.4
2053	E. F. Coe's Fish Guano and Potash	....	....	....	2.36	3.3	3.02	2.86	2.65	8.53	....	5.88	6.0	3.60	4.0*	6.40	35.00	22.03	58.9
2016	Economical Bone Fertilizer	....	.18	1.83	2.01	1.3	3.13	.66	.82	4.61	6.00	3.79	....	6.39	2.0*	12.56	32.00	18.96	68.7
1996	Wilkinson's Superphosphate	..	.09	2.13	2.22	1.7	3.50	.39	.78	4.67	....	3.89	....	5.30	3.0	7.62	38.00	18.93	100.8

* As Sulphate.

II. MANUFACTURERS' SAMPLES.

The analyses, tabulated on page 51, were made on samples deposited by manufacturers at the Station this year in accordance with the law, with a statement that they fairly represented the goods on sale in the State.

Their analysis is necessary because our agents did not find those brands in the stock which they inspected.

III. SAMPLES DRAWN BY PRIVATE INDIVIDUALS.

1949. Chittenden's Ammoniated Bone Phosphate, made by National Fertilizer Co., Bridgeport. Sampled and sent by C. H. Cables, Thomaston.

2040. Adams' High Grade Ammoniated Bone, made by W. P. Adams, 248 Front St., New York. Sampled and sent by request of the Station by J. B. Linsley, selling agent, Fair Haven.

ANALYSES AND VALUATIONS.

	1949.		2040.	
	Found.	Guaranteed.	Found.	Guaranteed.
Nitrogen in Nitrates	.67		----	
Nitrogen in Ammonia	.18		1.06	
Organic Nitrogen	2.92	1.7	1.60	
Total Nitrogen	3.77		2.66	2.5
Soluble Phosphoric Acid	4.41		6.97	10.0
Reverted Phosphoric Acid	4.99		1.56	
Insoluble Phosphoric Acid	4.76		.30	
Total Phosphoric Acid	14.16	9.0	8.83	
Potash	4.32	2.0	4.57	3.7
Chlorine	2.36		1.58	
Valuation per ton	$34.37		$27.48	
Cost	35.00		38.00	

SUPERPHOSPHATES FOR COMPARATIVE FIELD TEST.

Last spring the Station was asked to sample and analyze various fertilizers which had been sent to Shaker Station, for a comparison in the field, under arrangement with Mr. R. H. VanDeusen. The analyses are here given. The Station has no connection, other than this, with the tests which have been carried out.

2087. Church's Fish and Potash, from a lot of 1000 pounds.

2083. Economical Fertilizer, No. 3, made by Economical Fertilizer Co., Butler & Breed, selling agents. Stock of 800 pounds.

NITROGENOUS SUPERPHOSPHATES.—MANUFACTURER'S SAMPLES.

Station No.	Name or Brand.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Phosphoric Acid.							Potash.		Chlorine.	Valuation per Ton.
							Soluble.	Reverted.	Insoluble.	Total Phosphoric Acid.	Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.		
												Found.	Guaranteed.				
2071	Bradley's B. D. Sea Fowl Guano	.39	....	2.32	2 71	2.5	7.24	2.58	2.71	12.53	....	9.82	9.0	2.65	1.5	2.74	$28.70
2072	Bradley's Fish and Potash, Anchor Brand	....	....	3.97	3.97	3.3	2.82	2.36	1.59	6.77	....	5.18	3.0	3.88	3.0	8.85	26.20
2081	Clark's Cove Guano Co's Great Planet B. Fertilizer	....	2.59	1.99	4.58	4.9	4.43	2.34	.30	7.07	....	6.77	5.0	7.73	7.0	1.48	34.83
2078	Clark's Cove Guano Co's King Philip Alkaline Guano	....	.23	1.32	1.55	1.2	5.28	1.96	3.17	10.41	....	7.24	6.5	4.53	3.0	3.80	22.57
2070	Common Sense Fertilizer No. 22	.66	2.38	1.07	4.11	2.0	.21	7.39	3.63	11.23	9.0	7.30	....	1.78	1.0	1.75	29.30
2080	Crocker's Fertilizer and Chemical Works' Queen City Phosphate	....	....	1.64	1.64	1.7	5.53	3.47	2.12	11.12	....	9.00	8.0	1.50	1.1	1.53	22.34
2041	G. W. Miller's Flour of Bone Phosphate	.58	.09	2.49	3.16	....	.43	7.92	3.75	12.10	....	8.35	....	5.33	....	6.87	30.20
2076	C. Prentice's Phosphate	....	1.20	.92	2.12	....	5.28	5.18	4.51	14.97	....	10.46	....	2.76	....	2.72	28.70

2085. Mixture from F. Ellsworth, Hartford:

600	pounds	Castor Pomace.
100	"	Swift Sure Bone.
100	"	Swift Sure Superphosphate.
145	"	Muriate of Potash.

2054. Lister's Ammoniated Dissolved Bone.
2036. Mapes' Corn Manure.
2086. Sanderson's Formula A.
2082. Williams, Clark & Co's Americus Superphosphate.

HOME-MIXED FERTILIZERS.

The *manufacture* of superphosphate on the farm from phosphatic materials and oil of vitriol is not commonly a paying operation. The *mixing* of fertilizers on the farm, on the other hand, has proved itself in this and other States a very profitable undertaking in the hands of intelligent farmers who are able to pay cash for the raw materials and who purchase in ton lots or more, either singly or by clubbing together. It is stated by manufacturers that most agricultural chemicals can be bought nearly as cheaply in ton lots as in 100 ton lots, so that in the purchase of stock the one who manufactures on a small scale is at no very great disadvantage. Again, while the machinery of a fertilizer factory can undoubtedly mix a large lot of goods more cheaply than hand labor could do it, yet it does not follow that in all cases it costs more to mix on the farm.

It is safe to say that often the mixing of 2 or 3 tons of chemicals on the farm costs absolutely nothing because it is done at odd times by labor which is paid for but cannot be otherwise profitably employed during the winter and early spring. Again, there is greater security against inferior forms of nitrogen or phosphoric acid and their presence can be more easily detected in raw materials than in mixed goods.

Further, the purchaser saves more or less expense incident to the purchase of mixed goods, such as expenses of traveling and local agents, risks of the business and manufacturers' profits. Finally the intelligent farmer knows best what his land and special crops require and can suit these special needs by varying the composition of the mixture.

It is not claimed that everywhere and always home-mixtures are the most economical. It is often cheaper for the purchaser to buy the best commercial mixtures, ammoniated superphosphates

FERTILIZERS FOR COMPARATIVE FIELD TEST.

Station No.	Name or Brand.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.	Phosphoric Acid.					Potash.			Chlorine.	Valuation per Ton.
						Soluble.	Reverted.	Insoluble.	Total Phos. Acid.	Available Phos. Acid.	As Muriate.	As Sulphate.	Total Potash.		
2087	Church's Fish and Potash	....	.32	3.77	4.09	2.42	2.55	.51	5.48	4.97	4.05	....	4.05	6.20	$25.76
2088	Economical Fertilizer, No. 3	trace	....	.33	.33	....	.17	6.11	6.28	.17	.24	....	.24	10.18	4.07
2085	Mixed Fertilizer from F. Ellsworth, Hartford	....	....	4.49	4.49	1.54	4.78	.61	6.93	6.32	8.73	...	8.73	6.62	33.13
2054	Ammoniated Dissolved Bone Phosphate	....	1.04	1.17	2.21	10.60	1.36	.83	12.79	11.96	1.35	.19	1.54	1.02	28.60
2086	Sanderson's Formula A	1.45	.09	2.56	4.10	7.79	1.91	.31	10.01	9.70	7.87	....	7.87	7.54	36.12
2082	Americus Bone Superphosphate	....	.78	1.89	2.67	8.90	2.03	.37	11.30	10.93	.47	2.10	2.57	.36	29.57

and special manures, than to buy the chemicals and mix them, but the testimony of a yearly increasing number of farmers shows that often money may be saved by the seasonable purchase of raw materials and their use in home-mixtures. During the last year the Station has analyzed eleven home-mixed fertilizers and their analyses follow, together with details as to the materials employed. For table of analyses see page 57.

1916. Made by J. J. Webb, Hamden, from muriate of potash, sulphate of ammonia, dissolved bone black and tankage.

1976. Made by H. E. Bassett, Hamden, by the following formula:

2000	pounds	tankage	@ $26.00	per ton,	costing	$26.00
1500	"	dissolved bone black	@ 25.00	"	"	18.75
400	"	muriate of potash	@ 40.00	"	"	8.00
400	"	sulphate of potash	@ 30.00	"	"	6.00
4300	"					$58.75

Cost of ingredients per ton, $27.32. No estimate given of cost of mixing. Mr. Bassett bought in New Haven at current rates and had no freight charges additional to what he would have had for commercial fertilizers.

1980. Made by C. T. Merwin, Milford, by the following formula:

2500	pounds	dissolved bone black	@ $23.00	per ton,	costing	$28.75
1000	"	muriate of potash	@ 39.00	"	"	19.50
2000	"	fish scrap	@ 35.00	"	"	35.00
500	"	sulphate of ammonia	@ 67.50	"	"	16.88
000						$100.13
		To which add freight				4.00
		Cost of mixing				3.00
						$107.13

Cost of fertilizer, mixed, $35.71 per ton.

Mr. Merwin bought his dissolved bone black, muriate of potash and sulphate of ammonia below the usual retail market rate.

1981. Made by C. T. Merwin, Milford, by the following formula:

2500	pounds	dissolved bone black	@ $23.00	per ton,	costing	$28.75
1000	"	muriate of potash	@ 39.00	"	"	19.50
2000	"	tankage	@ 25.00	"	"	25.00
500	"	sulphate of ammonia	@ 67.50	"	"	16.88
6000						$90.13
		To which add freight				4.00
		Cost of mixing				3.00
						$97.13

Cost of fertilizer, mixed, $32.37.

As in the last case Mr. Merwin got his dissolved bone black, muriate of potash and sulphate of ammonia below the usual market rate.

1983. Made by J. C. Eddy, Simsbury, according to the following formula:

4000	pounds	animal dust	@ $27.00	per ton,	costing	$54.00
1635	"	dissolved bone black	@ 25.00	"	"	20.44
800	"	sulphate of potash	@ 30.00	"	"	12.00
565	"	muriate of potash	@ 40.00	"	"	11.30
7000						$97.74
		To which add freight to Simsbury				10.34
		Cost of mixing				3.00
						$111.08

Cost of the mixed fertilizer, $31.75 per ton.

The goods shrunk 50 pounds in mixing from drying out and mechanical loss.

2089. Potato Fertilizer. Made by C. S. Phelps at farm of C. M. Beach, West Hartford, by the following formula:

500	pounds	double manure salt	@ $22.50	per ton,	costing	$ 5.63
100	"	muriate of potash	@ 37.00	"	"	1.85
300	"	dried blood	@ 34.40	"	"	5.16
500	"	nitrate of soda	@ 47.20	"	"	11.80
600	"	dissolved So. Carolina rock,	@ 16.40	"	"	4.90
2000						$29.34
		To which add for freight and cartage				1.80
		Cost of mixing				1.50
						$32.64

Cost of the mixed fertilizer, $32.64 per ton.

The double manure salt, muriate of potash and nitrate of soda used in this and the next following fertilizer were purchased in New York, the other materials in Hartford.

2090. Corn Fertilizer. Made by C. S. Phelps at the farm of C. M. Beach, West Hartford, by the following formula:

1000	pounds	dissolved So. Carolina rock,	@ $16.40	per ton,	costing	$ 8.20
150	"	dissolved bone black	@ 24.00	"	"	1.80
200	"	dried blood	@ 34.40	"	"	3.44
350	"	nitrate of soda	@ 47.20	"	"	8.26
300	"	muriate of potash	@ 37.00	"	"	5.55
2000						$27.25
		To which add for freight and cartage				1.10
		Cost of mixing				1.50
						$29.85

Cost of the mixed fertilizer, $29.85 per ton.

2094. Made by N. S. Platt, Cheshire, from the following formula:

500 pounds tankage.
700 " sulphate of potash.
800 " dissolved bone black.

Mr. Platt purchased the materials somewhat under the usual market rate, so that they cost him $27.20 per ton in Cheshire *unmixed.*

2096. Made by Lyman H. Francis, Meriden, by the following formula:,

400 pounds muriate of potash.
400 " dissolved bone black.
400 " tankage.
800 " nitrate of soda.

At the regular market rates the cost would have been $43.30, unmixed. Mr. Francis purchased for $38.00.

2097. Made by N. S. Baldwin, Meriden, by the following formula:

400 pounds nitrate of soda.
800 " kainit.
800 " tankage.

At regular market rates the cost would have been $30.80. Mr. Baldwin states that he purchased for $20.50.

2151. Made by George F. Platt, Milford, by the following formula:

500	pounds sulphate of ammonia....@	$72.48	per ton,	costing	$18.12
3000	" bone, blood and meat....@	25.00	"	"	37.50
2000	" dissolved bone black......@	31.00	"	"	31.00
2000	" ground bone ......@	35.00	"	"	35.00
1000	" muriate of potash........@	43.50	"	"	21.75
1000	" sulphate of potash ......@	37.00	"	"	18.50
9500					$161.87

The prices do not include freight, but Mr. Platt by paying cash got such discounts from dealers' rates as made the goods cost $161.53 delivered in Milford. The cost of mixing was $4.72, so that the entire cost of 4¾ tons was $166.25 or $35.00 per ton.

In almost all cases the Station has analyzed the raw materials of which the mixture was made, so that it is possible to calculate the composition of the mixture, supposing all the goods to have been uniform in quality, the weights correct and the mixture uni-

HOME MIXED FERTILIZERS.

	1916		1976		1980		1981		1983		2089		2090		2094		2096		2097		2151	
	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.
Nitrogen as Nitrates	-----	---	-----	---	-----	---	-----	---	-----	----	3.93	---	2.85	--	-----	---	7.36	----	.77	---	-----	---
Nitrogen as Ammonia	1.89	---	-----	---	1.85	---	2.08	---	-----	----	-----	---	-----	--	-----	---	-----	----	-----	---	.98	---
Nitrogen (organic)	2.70	---	4.35	---	2.45	---	2.92	---	3.49	----	1.38	---	1.03	--	1.93	---	-----	----	3.63	---	3.57	---
Total Nitrogen	4.59	---	4.35	4.19	4.30	4.35	5.00	4.43	3.49	3.35	5.31	5.30	3.88	3.7	1.93	1.87	7.36	7.68	4.40	5.76	4.55	4.39
Soluble Phosphoric Acid	5.79	---	5.61	---	6.40	---	6.39	---	3.84	----	3.98	---	6.96	--	5.92	---	3.12	----	-----	---	3.09	---
Reverted Phosphoric Acid	2.46	---	1.31	---	2.19	---	1.93	---	4.85	----	.71	---	1.43	--	2.86	---	2.70	----	4.63	---	5.37	---
Insoluble Phosphoric Acid	.93	---	.43	---	.31	---	.44	---	1.75	----	.22	---	.48	--	1.01	---	.45	----	1.89	---	2.70	---
Total Phosphoric Acid	9.18	---	7.35	7.74	8.90	8.69	8.76	8.84	10.44	10.43	4.91	4.60	8.87	9.0	9.79	9.42	6.27	6.34	6.52	6.33	11.16	9.43
Potash as Muriate	7.97	---	6.02	---	10.20	---	10.69	---	4.56	----	4.18	---	8.14	--	1.39	---	9.28	----	5.95	---	7.40	---
Potash as Sulphate	-----	---	1.62	---	-----	---	-----	---	3.44	----	5.51	---	-----	--	8.16	---	-----	----	-----	---	-----	---
Total Potash	7.97	---	7.64	7.26	10.20	8.48	10.69	8.63	8.00	7.21	9.69	9.00	8.14	7.5	9.55	9.50	9.28	10.17	5.95	4.91	7.40	8.08
Chlorine	-----	---	4.54	---	-----	---	-----	---	-----	----	3.15	---	-----	--	1.05	---	8.04	----	12.66	---	5.00	---
Valuation per ton	$36.35	---	$33.33	---	$37.44	---	$39.96	---	$34.34	----	$34.59	---	$33.23	--	$31.29	---	$40.75	--	$28.30	---	$36.83	---
Cost per ton	-----	---	27.32*	---	35.71	---	32.37	---	31.75	----	32.64	---	29.80	--	27.20*	---	38.00*	----	-----	---	35.00	---

* Actual cost of ingredients unmixed.

form. It appears that there is in all but three cases a very satisfactory agreement between the actual and calculated quantities of nitrogen and phosphoric acid present, while the actual quantity of potash present is in all but one case larger than the calculated quantity. The discrepancies are greatest in Nos. **1981** and **2097.**

If the valuation of **1981** was based on the calculated rather than the actual composition of the sample it would be $36.23 instead of $39.96. If the valuation of **2097** were based on its calculated composition it would be a little over $30.00 and that of **2156** $34.57. In all but one case, however, valuation even if based on the calculated composition, is still not less than the cost.

The mechanical condition of the samples sent was certainly as good as that of the average commercial mixtures, hence it is fair to conclude that those who made these mixtures instead of buying commercial mixtures of average composition saved some 20–25 per cent. of their outlay, since the average retail cash price of nitrogenous superphosphates is from 20–25 per cent. higher than their valuation. In order to buy to the best advantage cash payment and orders for some considerable quantity of material are necessary. For the information of those interested is here appended a form taken with slight alterations from a circular sent to dealers in fertilizer chemicals by the Moorestown Grange in New Jersey, and which may be convenient for the use of granges and farmers' clubs in this State.

"Wanted: to buy the materials to make ——— tons *or more* of fertilizer. The materials to consist of nitrate of soda, sulphate of ammonia, acid phosphate, dissolved bone or bone black, fine ground bone, fine ground fish scrap, muriate of potash and sulphate of potash.

All materials to be in good mechanical condition; in good bags; to run even weights or be plainly marked what each bag contains *net*, and to be delivered at ——— early in March next. All materials to be guaranteed to contain certain percentages of nitrogen, potash, or available phosphoric acid, as the case may be; one-half the bill to be paid within ten days after receipt of goods; on the other half a credit of sixty days to be allowed, within which time samples will be sent to the Connecticut Experiment Station for analysis, and if there found to contain as large percentages as guaranteed the balance of bill will be paid within the sixty days, but if any are found to contain a *less* percentage than guaranteed, then a discount is to be allowed on the bill equal to the loss in money value caused by such deficiency for the first one per cent. or fraction thereof, and *twice* the loss in money value for all deficiencies in excess of one per cent., and balance of bill within the sixty days. Samples to be taken by a station agent or other disinterested party."

SPECIAL MANURES.

I. *Sampled by Station Agents.*

The tables on pages 61 to 65, contain twenty analyses of this class, which were made on samples known to fairly represent the stock from which they were taken. Of some, several samples were secured, and the analysis was made on a mixture of them as already explained on page 33.

The retail cash price of Fairchild's Formula for Corn and Wheat, No. **2068**, was reduced August 1, from $46 to $44 per ton.

In April an analysis was made on a mixture of three samples of Baker's Special Potato Fertilizer. Objection was made to this analysis by the manufacturer, on the ground that it did not fairly represent the quality of this brand. This analysis is numbered **1937** in the table on page 60. To show whether this analysis was or was not fairly representative, the Station took the trouble to analyze separately every sample of this one brand which we had collected. The analyses are given in the table, page 60. Finally the five separate analyses were averaged to give the figures printed in the table on page 65—No. **2126.**

These analyses show that the first analysis made on a mixture did fairly represent the brand, they show the general uniformity in the goods, and also furnish an illustration of the desirability of analyzing mixtures of samples instead of depending on a single sample. For while an analysis of either of four samples would have given a correct statement of the character of the goods, an analysis of the fifth alone would have given a showing less correct and more favorable.

Cost and Valuation.—The average cost of the special manures sampled by the Station has been $42.52, and the average valuation $35.20. The difference, $7.32, makes the percentage difference 20.9. The corresponding difference in case of the superphosphates was 25.6. This year, as heretofore, the special manures as a class have been higher priced but more concentrated than the other nitrogenous superphosphates, and if the quality of the raw materials composing them is equally good, they have been the more economical to purchase.

BAKER'S POTATO FERTILIZER.

	A Mixture of the three following samples.	Stock of R. B. Bradley & Co.	Stock of C. O. Jeliff & Co., March 22.	Stock of Dennis Fenn.	Stock of Allen Betts.	C. O. Jeliff & Co. May 19.	Average of the five preceding.
	1937	**1989**	**1990**	**1991**	**1992**	**2068**	**2126**
Nitrogen as Ammonia	3.14	3.05	3.24	3.01	3.24	3.70	3.25
Organic Nitrogen	.59	.42	.54	.65	.61	.58	.56
Total Nitrogen	3.73	3.47	3.78	3.66	3.85	4.28	3.81
Soluble Phosphoric Acid	5.87	5.76	5.90	6.56	6.68	5.71	6.12
Reverted Phosphoric Acid	.58	.48	.85	.27	.26	.87	.55
Insoluble Phosphoric Acid	.21	.25	.27	.06	.10	.20	.18
Total Phosphoric Acid	6.66	6.49	7.02	6.89	7.04	6.78	6.84
Potash	10.24	10.20	9.81	10.57	9.13	10.17	9.98
Chlorine	4.24	3.32	3.96	5.54	5.54	6.43	4.96
Valuation per ton	$33.31	32.55	33.58	33.55	33.65	34.60	33.39

SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2068	Fairchild's Corn Formula.	The Rogers & Hubbard Co., Middletown, Conn.	Strong & Backus, Colchester.	$46.00	$46.00
2030	Complete Manure for Potatoes and Vegetables.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	E. S. Gillette, Easton.	....	42.00
			J. A. Lewis, Willimantic.	42.00	
			Chas. Jennings & Son, Southport.	43.00	
			J. W. Beach, Stratford.	45.00	
2050	Complete Manure for Corn and Grain.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	S. Stevens, Glastonbury.	42.00	42.00
1936	Quinnipiac Potato Manure.	Quinnipiac Co., New London, Conn.	E. A. Godfrey, Southport.	38.00	38.00
2056	Tobacco Manure for Use with Stems.	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	Mapes' Branch, Hartford.	46.00	46.00
2057	Grass and Grain Spring Top Dressing.	Mapes' Formula and Peruvian Guano Co., 158 Front St., New York.	Birdsey & Foster, Meriden.	44.50	43.00
			Dean & Horton, Stamford.	44.00	
2027	Stockbridge Forage Crop Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Brewster & Burnett, Norwich.	42 50	40.00
			R. S. Converse, Stafford.	42.00	
			Southington Lumber and Feed Co., Southington.	41.50	
1930	Mapes' Potato Manure.	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	R. B. Bradley & Co., New Haven.	45.00	45.00
			Mapes' Branch, Hartford.	45.00	
			W. W. Cooper, Suffield.	43.00	
2051	Bradley's Complete Top Dressing for Grass and Grain.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Burtis & Mead, New Canaan.	42.00	42.00
1998	Stockbridge Potato and Vegetable Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	T. Pease & Sons Co., Windsor Locks.	43.00	40.00
			H. K. Brainard, Thompsonville.	40.00	
2055	Mapes' Tobacco Manure (Conn. Brand).	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	W. W. Cooper, Suffield.	46.00	46.00

SPECIAL MANURES SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2036	Mapes' Corn Manure.	Mapes' Formula & Peruvian Guano Co., 158 Front St., New York.	R. H. Van Deusen, Shaker Station	$44.00	$43.00
			J. P. Barstow, Norwich.	43.00	
			J. O. Fox & Co., Putnam.	46.00	
			Southington Lumber and Feed Co., Southington.	43.00	
			Dunham & Co., Cheshire.	45.00	
			Wilson & Burr, Middletown.	43.00	
			W. W. Cooper, Suffield.	43.00	
2063	Baker's Special Potato Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. O. Jelliff & Co., Southport.	43.00	45.00
1964	Bradley's Potato Manure.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	J. W. Beach, Stratford.	38.00	38 00
			Mather & Gruman, Darien.	38.00	
			Burtis & Mead, New Canaan.	40.00	
			Chas. Jennings, Southport.	38.00	
			A. A. Hubbard, Canaan.	38.00	
2035	Lister's Potato Manure.	Lister Agricultural and Chemical Works, Newark, N. J.	C. Swan, State St., Bridgeport.	45.00	----
			A. N. Clark, Milford.	40.00	
2049	Tobacco and Onion Manure.	Williams & Clark Co., Hanover Square, New York.	N. H. Smith & Co., Norwalk.	44.00	42.00
			E. M. Jennings, Southport.	42.00	
1973	Americus Special Fertilizer for Potatoes.	Williams, Clark & Co., New York.	D. B. Wilson & Co., Waterbury.	42.00	42.00
			E. M. Jennings, Southport.	42.00	
			J. Goodman, E. Litchfield.	41.50	
			Atwood & Wilson, Watertown.	45.00	

SPECIAL MANURES SAMPLED BY THE STATION—*Continued.*

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Manufacturer's statement of average cash price per ton.
2001	Stockbridge Grain Manure.	Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Hubbell & Bradley, Saugatuck.	$43.00	$40.00
			T. Pease & Sons Co., Windsor Locks.	43.00	
			Dunham & Co., Cheshire.	45.00	
			Southington Lumber and Feed Co., Southington.	41.50	
2002	Potato, Hop and Tobacco Phosphate.	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	J. S. Bragg, Canaan.	37.00	----
			J. H. Reay, Greenwich.	38.00	
			E. T. Morehouse, New Hartford.	40.00	
			J. M. Belden, New Britain.	40.00	
2126	Special Potato Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. O. Jeliff & Co., Southport.	45.00	45.00
			Dennis Fenn, Milford.	45.00	
			R. B. Bradley & Co., New Haven.	45.00	
			C. O. Jeliff & Co., Southport.	43.00	
			Allen Betts, Norwalk.	44.00	
2064	Baker's Complete Corn Manure.	H. J. Baker & Bro., 215 Pearl St., New York.	C. O. Jeliff & Co., Southport.	45.00	45.00
			R. B. Bradley & Co., New Haven.	----	

ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION.

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
2068	Fairchild's Corn Formula	3.81	....	1.90	5.71	....	....	....	....	13.71	....	...	....	13.28§	....	....	$46.00	$45.49	1.1
2030	Bradley's Complete Manure for Potatoes and Veg'bles	.62	1.06	2.31	3.99	3.8	9.31	1.89	.54	11.74	....	11.20	8.0	6.08	6.0	.98	42.00	38.20	9.9
2050	Bradley's Complete Manure for Corn and Grain	.79	.51	3.26	4.56	3.7	8.02	1.57	.69	10.28	10.0	9.59	9.0	7.14	5.5	4.72	42.00	37.62	11.6
1936	Quinnipiac Potato Manure	.52	.69	2.91	4.12	3.3	3.42	4.08	2.20	9.70	....	7.50	5.0	6.36	6.0	.93	38.00	33.87	12.2
2056	Mapes' Tobacco Manure for Use with Stems	.66	2.41	2.43	5.50	5.4	7.82	2.95	1.45	12.22	10.5	10.77	....	3.86	3.5	.37	46.00	40.99	12.2
2057	Mapes' Grass and Grain Top Dressing	.83	1.87	1.94	4.64	4.1	5.97	4.66	1.68	12.31	7.0	10.63	....	6.50	5.0	5.91	44.00‡	39.07	12.6
2027	Stockbridge Forage Crop	.51	2.36	2.79	5.66	5.5	5.86	1.41	1.78	9.05	6.0	7.27	5.0	2.85	2.5	1.58	41.50	34.84	19.1
1930	Mapes' Potato Manure	1.61	1.55	.69	3.85	3.7	4.89	4.50	3.68	13.07	8.0	9.39	....	7.50	6.0*	.66	45.00	37.80	19.1
2051	Bradley's Complete Top Dressing for Grass and Grain	4.15	....	.38	4.53	4.1	4.99	2.96	2.98	10.93	7.0	7.95	6.0	5.62	5.0	trace	42.00	35.00	20.0
1993	Stockbridge Potato and Vegetable Manure	....	2.45	1.03	3.48	3.3	6.93	2.72	1.64	11.29	....	9.65	8.0	5.68	7.0	6.38	40.00	33.15	20.7
2055	Mapes' Tobacco Manure [Conn. Brand]	.54	2.69	1.42	4.65	4.7	6.97	1.20	.24	8.41	7.8	8.17	....	7.53	7.8	.44	46.00	37.34	23.2
2036	Mapes' Corn Manure	1.14	1.29	1.51	3.94	3.7	5.37	3.97	3.08	12.42	10.0	9.34	....	6.77	6.0	6.26	43.00	35.60	23.6
1964	Bradley's Potato Manure	.42	...	2.68	3.10	2.7	6·04	1.71	2.22	9.97	8.0	7.75	6.0	6.16	6.0	3.76	38.00	29.81	27.5
2035	Lister's Potato Manure	.61	1.85	1.66	4.12	3.7	8·22	.41	.12	8.75	....	8.63	8.5	5.90	7.0	4.42	42.50	33.12	28.3

* As Sulphate.

§ As Muriate.

‡ Manufacturer quotes $43 which would make the percentage difference 10.0.

ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION—*Concluded.*

Station No.	Name or Brand.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Cost per Ton.	Valuation per Ton.	Percentage Difference between Cost and Valuation.
												Available.							
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
2049	Williams, Clark & Co.'s Tobacco and Onion Manure.	....	1.75	2.88	4.63	4.0	3.93	1.22	.65	5.80	5.0	5.15	....	7.19	8.0	.54	$42.00	$32.45	29.4
1973	Americus Special for Potatoes	....	2.04	1.36	3.40	3.3	5.60	1.44	.33	7.37	7.0	7.04	....	8.10	8.0	trace	42.00	32.13	30.7
2001	Stockbridge Grain Manure	....	1.39	1.88	3.27	3.3	7.89	2.10	1.77	11.76	7.0	9.99	6.0	3.95	4.0	4.32	41.50†	31.63	31.2
2002	Potato, Hop and Tobacco Phosphate	....	trace	2.47	2.47	2.0	8.21	2.44	.66	11.31	....	10.65	8.0	3.96	3.5	3.64	39.00	29.22	33.4
2126	Baker's Special Potato Manure	....	3.25	.56	3.81	3.3	6.12	.55	.18	6.84	....	6.67	5.8	9.98	10.0	4.96	45.00	33.39	34.7
2064	Baker's Complete Corn Manure	....	3.58	.74	4.32	5.0	6.57	.46	.16	7.19	....	7.03	6.3	8.08	7.0	11.03	45.00	33.29	35.2

† Manufacturer quotes $40 which would make the percentage difference 26.4.

II. *Manufacturer's Sample.*

PRENTICE'S POTATO PHOSPHATE.

2077. This is the only manufacturer's sample of a special fertilizer analyzed this year. Analyses of all other special fertilizers sold in the State have been made on samples collected by agents of the Station.

	2077.
Nitrogen as Ammonia	2.22
Organic Nitrogen	.67
Soluble Phosphoric Acid	6.35
Reverted Phosphoric Acid	2.18
Insoluble Phosphoric Acid	3.05
Potash	8.78
Chlorine	8.46
Valuation per ton	$32.84

III. *Sampled by Private Individuals.*

PEACH YELLOWS CURE.

2093. Made by H. J. Baker & Bro., New York. Sampled and sent by N. S. Platt, from stock of C. S. Gillette, Cheshire.

Nitrogen	.37
Soluble Phosphoric Acid	9.92
Reverted Phosphoric Acid	1.18
Insoluble Phosphoric Acid	none.
Potash	11.68
Chlorine	11.16
Cost per ton	$38.00

BONE MANURES.

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" applied to fertilizers, may in some cases, signify material made from dry, clean and pure bones such as shank bones used in making knife handles; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon and grease—and if taken from garbage or ash heaps, with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which have been cooked in steam-tanks in order to recover grease, and are then dried and sold as "tankage;" or, finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. The nitrogen of all these varieties of bone when they are in the same state of mechanical subdivision has essentially the same fertilizing value.

I. *Sampled by the Station.*

On pages 69–71 will be found 19 analyses of bone manures made on samples collected by agents of the Station.

Of these the following appear to be strictly pure ground raw bone:

1903, 1905 and **2136,** H. J. Baker's Strictly Pure Bone; and **2061**, made by the Rogers & Hubbard Co.; and **2060,** made by the Crocker Fertilizer Co.

The following are tolerably clean cooked bone: **1904** and **2133,** Quinnipiac Co.'s; **1907,** Darling's; **1933,** Meyer's; **1958,** Chittenden's; **1961,** Bradley's, and **2125,** Armour's. **1967** is bone from which the nitrogen has been largely extracted in the process of glue manufacture. Sanderson's Bone, **1894** and **2120** is apparently a mixture of bone and tankage. Lister's Bone, **1934,** and Coe's Bone, **1906** and **2004,** are mixtures of tankage, bone and salts.

In Bulletin No. 91, issued in April last, it was stated that Swift Sure Bone, **1908,** and Americus Pure Bone, **1927,** were mixtures of bone and tankage. An inspection of the samples and the fact that they contain a larger percentage of nitrogen than other grades of pure bone usually contain,—6.57 and 4.44 per cent.—while the per cent. of phosphoric acid is rather low for a pure bone—19.44 and 18.24—led us to this conclusion. The manufacturers have since informed us that the goods are not mixtures of bone and tankage.

The Swift Sure Bone is stated to consist of bone from which all adhering meat is removed and which is dried and deprived of all grease by a process which leaves the material dry, brittle and very porous. The Americus Pure Bone is stated to be made from green butcher's bones which are put in steam-tight tanks and subjected to pressure which removes the grease. The entire product remaining in the tank is dried and ground.

The system of valuation of bone, which depends on the mechanical condition of the sample as well as on its chemical analysis, has already been explained on page 29.

Leaving out of account the two samples of E. F. Coe's bone, **1906** and **2004,** and Lister's bone, **1934,** which contain a considerable quantity of alkaline salts, the average cost per ton of the fifteen samples, whose cost and valuation are both given, is $35.00, and the average valuation is $40.41. Since bone is a raw material and not a mixed fertilizer its valuation should agree pretty closely with its average market price.

The figures indicate that the Station schedule of valuations is too high as far as it applies to bone manures.

There are three analyses of H. J. Baker's Bone in the table. Two were made in the spring, and the third, **2136,** in the fall, from a stock of 70 tons. Competition being at this time and place very active, the price was cut to $32.00, the regular price being $35.00. A second analysis of Quinnipiac Bone, **2133,** was made from stock sampled last spring, at the request of the manufacturers who believed the first analysis, **1904,** did not fairly represent the quality of the goods.

II. *Sampled by manufacturers and private individuals.*

On page 72 are four analyses of samples of bone furnished by manufacturers in compliance with the terms of the fertilizer law.

PECK'S PURE GROUND BONE.

2114. Made by Peck Brothers, Northfield. Sampled by Apothecaries Hall Co., Waterbury, from their stock.

MECHANICAL ANALYSIS.

Fine, smaller than	1/50 inch	10
Fine medium, smaller than	1/25 "	15
Medium, smaller than	1/12 "	38
Coarse medium, smaller than	1/6 "	35
Coarse, larger than	1/6 "	2
		100

ANALYSIS AND VALUATION.

Nitrogen	4.41
Phosphoric acid	21.62
Cost per ton	$32.00*
Valuation per ton	$31.95

* Cash at mill.

In bulletin No. 88, July, 1886, the price of Peck Brothers' Pure Bone at the dealer's store was given as $35.00, and in a foot note, the price at mill was given, $33.00. In the annual report for 1886 the quotation *at mill* was omitted by an oversight.

BONE MANURES.—SAMPLED BY STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost Per Ton.
1967	Peter Cooper's Pure Bone Dust.	Peter Cooper's Glue Factory, 16 Burling Slip, New York City.	W. B. Meeker, Southport. Wilson & Burr, Middletown.	$28.00 28 00
2136	Baker's Strictly Pure Ground Bone.	H. J. Baker & Bro., 215 Pearl St., New York City.	C. O. Jelliff & Co., Southport.	32.00
2125	Armour's Bone.	Armour Glue Works, 205 La Salle St., Chicago, Ill.	R. A. Moore, Berlin.	32.00
1903	Baker's Strictly Pure Ground Bone.	H. J. Baker & Bro., 215 Pearl St., New York City.	C. O. Jelliff & Co., Southport.	35.00
2133	Quinnipiac Bone Meal.	Quinnipiac Co., New London, Conn.	R. B. Bradley & Co., New Haven.	
			W. F. Benedict, Stepney Depot.	36.00
			Olds & Whipple, Hartford.	37.00
			Chandler & Morse, Putnam.	34.00
			E. A. Godfrey, Westport.	34.00
1961	Bradley's Fine Bone.	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Chas. Jennings & Son, Southport.	35.00
2120	Fine Ground Bone.	L. Sanderson, Long Wharf, New Haven.	Robt. Aitken, Shaker Station.	35.00
1894	Ground Bone.	L. Sanderson, Long Wharf, New Haven.	Manufacturer.	35.00
1904	Quinnipiac Bone Meal.	Quinnipiac Co., New London.	E. A. Godfrey, Southport. R. B. Bradley, New Haven.	36.00
1908	Swift Sure Bone Meal.	M. L. Shoemaker & Co., Philadelphia.	F. Ellsworth, Hartford.	40.00

BONE MANURES.—SAMPLED BY STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Cost per ton.
2060	Ground Bone.	Crocker Fertilizer & Chemical Works, Buffalo, N. Y.	J. E. Leonard, Jewett City. G. S. Bragg, Canaan.	$40.00 38.00
2061	Pure Ground Bone, A. X. Brand.	Rogers & Hubbard Co, Middletown.	Wilson & Burr, Middletown.	32.00*
1933	Pure Ground Bone.	C. Meyer, Jr., Maspeth, L. I.	G. F. Platt, Milford.†	35.00‡
1905	Baker's Strictly Pure Bone. "A"	H. J. Baker & Bro., 215 Pearl Street, New York.	C. O. Jeliff & Co., Southport.	35.00
1927	Americus Brand Pure Bone Meal.	Williams & Clark Co., Hanover Square, New York City.	R. B. Bradley & Co., New Haven.	36.00§
1906	E. F. Coe's Ground Bone.	E. F. Coe, 16 Burling Slip, New York.	Simon Banks, Southport.	28.00
2004	E. F. Coe's Ground Bone.	E. F. Coe, 16 Burling Slip, New York.	J. F. Silliman, New Canaan. Wheeler & Howes, Bridgeport. D. P. Penfield, Danbury.	35.00 32.00 35.00
1934	Lister's Celebrated Ground Bone.	Lister Fertilizer and Chemical Works, Newark, N. J.	A. N. Clark, Milford.	28.00
1907	Darling's Fine Ground Bone.	L. B. Darling Fert. Co., Pawtucket, R. I.	R. B. Bradley & Co., New Haven.	
1958	Chittenden's Ground Bone or Fine Animal Bone.	National Fertilizer Co., Bridgeport.	Mattabesett Grange, Middletown.	

* Sold by manufacturer for $30 *cash* f. o. b. Middletown. † From stock purchased for his own use. ‡ At Milford.
§ Manufacturer's price.

ANALYSES OF BONE MANURES.—SAMPLED BY STATION.

Station No.	Name or Brand.	Chemical Analysis.		Mechanical Analysis.					Cost per ton.	Valuation per ton.	Percentage difference between cost and valuation.
				Finer than				Coarser than 1/6 inch.			
		Nitrogen.	Phos. Acid.	1/50 inch.	1/25 inch.	1/12 inch.	1/6 inch.				
											Valuation exceeds cost.
1967	Peter Cooper's Pure Bone Dust	1.34	31.35	44	18	22	16	--	$28.00	$40.69	31.1
2136*	H. J. Baker's Strictly Pure Bone	3.89	23.38	73	27	--	--	--	32.00‡	43.49	26.4
2125	Armour's Bone	3.31	26.56	51	21	23	5	--	32.00	42.34	24.4
1903*	H. J. Baker's Strictly Pure Ground Bone	3.80	22.78	81	19	--	--	--	35.00	42.90	18.4
2133†	Quinnipiac Bone Meal	2.82	26.00	67	19	13	1	0	36.00	42.38	15.5
1961	Bradley's Fine Bone	3.38	23.88	67	19	14	--	--	35.00	41.37	15.4
2120	Sanderson's Fine Ground Bone	3.94	22.07	60	40	--	--	--	35.00	41.09	14.9
1894	Sanderson's Ground Bone	3.86	21.78	65	35	--	--	--	35.00	40.78	14.1
1904†	Quinnipiac Bone Meal	2.59	25.54	65	19	16	--	--	36.00	40.91	12.0
1908	Shoemaker's Swift Sure Bone Meal	6.57	19.44	65	25	10	--	--	40.00	45.31	11.7
2060	Crocker Fertilizer and Chemical Works, Ground Bone	3.79	24 65	56	24	20	--	--	38.00	42.51	10.6
2061	Rogers & Hubbard Pure Ground Bone, Grade AX Brand	3.79	22.01	28	26	26	20	--	32.00	34.78	8.0
1933	C. Meyer's Pure Ground Bone	3.49	19.47	60	40	--	--	--	35.00	36.31	3.6
1905*	H. J. Baker's "A" Strictly Pure Bone	3.44	18.81	67	32	1	--	--	35.00	35.59	1.6
1927	Americus Brand Pure Bone Meal	4.44	18.24	58	22	16	4	--	36.00	36.17	.5
											Cost exceeds valuation.
1906	E. F. Coe's Ground Bone	2.73	14.85§	54	19	15	8	4	28.00	27.98	.1
2004	E. F. Coe's Ground Bone	3.16	14.24‖	64	18	10	8	--	32–35	29.88	12.1
1934	Lister's Celebrated Ground Bone	2.90	12.82	38	20	20	22	--	28.00	22.54	24.2
1907	Darling's Fine Ground Bone	3.00	24.51	79	19	2	--	--	----	42.51	---
1958	Chittenden's Fine Animal Bone	3.55	23.72	43	24	21	12	--	----	38.28	---

* Compare the three analyses **1903**, **1905** and **2136** in this table.

† Compare the two analyses **2133** and **1904** in this table.

‡ Regular price $35.00.

§ Also contains 2.46 per cent. of potash.

‖ Also contains 2.80 per cent. of potash.

ANALYSES OF MANUFACTURERS' SAMPLES OF BONE MANURES.

Station No.	Name or Brand.	Chemical Analysis.		Mechanical Analysis.					Valuation per Ton.
				Finer than				Coarser than $\frac{1}{6}$ inch.	
		Nitrogen.	Phos. Acid.	$\frac{1}{50}$ inch.	$\frac{1}{25}$ inch.	$\frac{1}{12}$ inch.	$\frac{1}{6}$ inch.		
2123	L. M. Meyer's Bone Manure	4.20	20.83	53	23	18	6	--	*$37.99
2127	G. W. Miller's Pure Ground Bone	3.93	22.52	23	14	26	37	--	†33.35
2078	C. Prentice's Bone	4.09	22.04	39	35	17	9	--	38.14
2153	The Rogers & Hubbard Co's Pure Raw Knuckle Bone Flour	3.82	25.61	76	21	3	--	--	46.28

* Cost $37 f. o. b. Middletown.

† Cost $32 per ton.

BONE AND POTASH.

Two samples of bone containing potash, No. **1906** and **2004**, have been classed with the bone manures already discussed, because sold as "bone."

2154. Fairchild's Formula Bone and Potash made by the Rogers & Hubbard Co., Middletown. Sampled by the manufacturer.

MECHANICAL ANALYSIS.

Fine, smaller than	$\frac{1}{50}$ inch	36
Fine medium, smaller than	$\frac{1}{25}$ "	17
Medium, smaller than	$\frac{1}{12}$ "	33
Coarse medium, smaller than	$\frac{1}{6}$ "	14
		100

CHEMICAL ANALYSIS AND VALUATION.

Nitrogen	2.60	per cent.
Phosphoric Acid	16.25	"
Potash	17.70	"
Valuation	$10.75	
Cost	35.00	

TANKAGE.

This material consists of various kinds of offal but chiefly of cooked bone and meat which collects on the bottom of the tanks in which grease is separated from the waste of slaughter-houses and meat markets. As the analyses show it varies greatly in composition. On the valuation of Tankage see page 91.

1960. No. 1, sold by National Fertilizer Co., Bridgeport, to the Meriden Grange.

1959. No. 2, sold by National Fertilizer Co., to the Meriden Grange.

1889. Western Tankage from stock of L. Sanderson, New Haven.

1891. New York Tankage from stock of L. Sanderson, New Haven.

2122. Sold by L. Sanderson, New Haven, to Robert Aitkin, Shaker Station.

1946. Made by Sperry & Barnes, New Haven. From lot bought by G. F. Platt, Milford.

1948. Made by Sperry & Barnes. From lot bought by H. E. Bassett, New Haven.

MECHANICAL ANALYSES.

	1960	**1959**	**1889**	**1891**	**2122**	**1946**	**1948**
Fine, smaller than $\frac{1}{50}$ inch	46	54	65	75	72	46	54
Fine medium, smaller than $\frac{1}{25}$ inch	29	23	22	14	15	19	21
Medium, smaller than $\frac{1}{12}$ inch	20	17	12	9	11	14	13
Coarse medium, smaller than $\frac{1}{6}$ inch	5	6	1	2	2	10	6
Coarse, larger than $\frac{1}{6}$ inch	0	0	0	0	0	11	6
	100	100	100	100	100	100	100

CHEMICAL ANALYSES AND VALUATIONS.

	1960	**1959**	**1889**	**1891**	**2122**	**1946**	**1948**
Nitrogen	7.51	6.52	7.46	5.38	5.53	8.20	8.99
Phosphoric acid	9.02	15.60	12.44	19.24	18.83	5.98	4.76
Cost per ton $			38.00	38.00	35.00	25.00	26.00
Valuation per ton	$32.62	38.40	38.60	41.87	41.47	29.18	31.39

ANIMAL DUST.

Sampled by private individuals.

1984. Finest Animal Dust. Sampled by S. T. Stockwell, Simsbury.

1982. Animal Dust. Sampled by J. C. Eddy, Simsbury. Both made by the L. B. Darling Fertilizer Co., Pawtucket R. I., and bought direct from the company.

MECHANICAL ANALYSES.

	1984	**1982**
Fine, smaller than $\frac{1}{50}$ inch	41	31
Fine medium, smaller than $\frac{1}{25}$ "	18	14
Medium, smaller than $\frac{1}{12}$ "	24	32
Coarse medium, smaller than $\frac{1}{6}$ "	17	23
	100	100

ANALYSES AND VALUATIONS.

	1984	**1982**
Nitrogen	6.01	5.72
Phosphoric acid	10.96	12.59
Cost per ton	$27.00	27.00
Valuation per ton	$29.19	28.85

DRIED BLOOD.

Pure dried blood, prepared at large slaughter houses by drying the blood with superheated steam, contains from 10 to 15 per cent. of nitrogen, depending on the degree of dryness. It contains besides the animal tissue of which the nitrogen forms a part, a small fraction of a per cent. each of phosphoric acid and potash, and from 8 to 15 or more per cent. of water. It is sold usually on a guarantee of so many "units of ammonia." For explanation of this term, see page 87. "Blood and Meat," "Blood and Bone," etc., as their names imply, are different things, being mixtures of various kinds of slaughter-house offal containing less nitrogen and often considerable quantities of phosphoric acid from bones.

2007. Stock of C. M. Beach, West Hartford. Last years' stock used in home mixtures described further on.

2124. Made by Armour & Co., Chicago, Ill. Stock of R. A. Moore, Berlin.

2149. Sold by Bradley Fertilizer Co., Boston, Mass. Stock of A. A. Hubbard, Canaan.

1914. Stock of L. Sanderson, New Haven.

ANALYSES.

	2007	**2124**	**2149**	**1914**
Nitrogen	9.15	13.04	11.21	12.65
Cost per ton	$34.40*	38.00	38.00	43.00
	cts.	cts.	cts.	cts.
Nitrogen costs per pound	18.8	14.6	16.9	17.0

* Including freight to farm.

TALLOW SCRAP.

A sample of wet meat **1902**, from a rendering establishment, brought to the station by Mr. J. H. Dickerman of Mt. Carmel, contained—

Water	66.00	per cent.
Nitrogen	3.07	"
Phosphoric acid	1.18	"

The material could only be well used for composting, being too coarse for direct application to the land.

CASTOR POMACE.

This is the ground residue or cake of castor beans from which castor oil has been extracted by pressure.

2059. Made by H. J. Baker & Bro., New York. Stock of W. W. Clark, Simsbury.

1995. Made by Collier White Lead and Oil Co., St. Louis, Mo. Stock of F. Ellsworth, Hartford.

1994. Made by St. Louis Lead and Oil Co., St. Louis, Mo. Stock of Olds & Whipple, Hartford.

ANALYSES AND VALUATIONS.

	2059	1995	1994
Nitrogen	5.86	5.70	5.77
Phosphoric Acid	1.99	1.70	1.87
Potash	1.07	1.02	1.00
Cost per ton	$19–20	$20.00	$19.00
Valuation per ton	$24.21	$23.20	$23.67

These three samples from different manufacturers show a close agreement in composition. For valuation, nitrogen has been reckoned at 17½ cents, phosphoric acid at 7 cents (as in fine bone and in fish scrap) and potash at 4¼ cents per pound. If these valuations are given to the phosphoric acid and potash, then the actual average cost of nitrogen in these samples is 14.1 cents per pound, which shows that the pomace has been this year the cheapest form of readily available nitrogen in the Connecticut market.

NITRATE OF SODA.

Nitrate of Soda is mined in Chili and purified there before shipment. It contains usually about 16 per cent. of nitrogen, equivalent to 97 per cent. of pure nitrate of soda. It contains besides, a little salt and some moisture. The usual guarantee is "96 per cent." of nitrate of soda equivalent to 15.8 per cent. of nitrogen.

1915. Stock of L. Sanderson, New Haven.

1956. Sold by National Fertilizer Co., Bridgeport, to Mattabesett Grange, Middletown.

2145. Sold by the Quinnipiac Co., New London. Stock of Wilson & Burr, Middletown.

2146. Sold by Mapes Branch, Hartford.

ANALYSES.

	1915	1956	2145	2146
Water	1.45	2.20	1.40	1.00
Salt	.39	.84	1.25	1.09
Sulphate of Soda	.27	.30	.25	.53
Nitrate of Soda	97.89	96.66	97.10	97.38
	100.00	100.00	100.00	100.00
Nitrogen	16.12	15.92	15.99	16.04
Cost per ton	$55.00		52.50	60.00
Nitrogen costs per pound, cts.	17.0		16.4	18.7

SULPHATE OF AMMONIA.

This article, now manufactured on a large scale as a by-product of gas-works, usually contains over 20 per cent. of nitrogen, the equivalent of from 94 to 97 per cent. of sulphate of ammonia. The rest is chiefly moisture. The usual guarantee is 25 per cent. of ammonia which is equivalent to 20.6 per cent. of nitrogen, but commercial sulphate of ammonia commonly contains less than that quantity.

1940. Made by C. Meyer Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

1911. Stock of L. Sanderson, New Haven.

2144. Stock of Mapes Branch, Hartford.

ANALYSES.

	1940	1911	2144
Nitrogen	20.37	20.37	19.93
Equivalent Ammonia	24.74	24.74	24.20
Cost per ton	$72.48*	70.00	73.00
	cts.	cts.	cts.
Nitrogen costs per pound	18.3	17.1	18.3

* Including freight from N. Y.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

This article is usually sold as "sulphate of potash" on a guarantee of "48–50 per cent. sulphate" which is equivalent to 25.9–27 per cent. of actual potash. It contains, besides some 46–50 per cent. of sulphate of potash, over 30 per cent. of sulphate of magnesia,* chlorine equivalent to 3 per cent. of common salt, besides sulphates of soda and lime, with varying quantities of moisture.

1892. Stock of L. Sanderson, New Haven.

1945. Sold by C. Meyer, Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

1951. Sold by National Fertilizer Co., Bridgeport, to Mattabesett Grange, Middletown.

1952. Sold by National Fertilizer Co., Bridgeport, to Meriden Grange.

2137. Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

2138. Sold by Williams, Clark & Co., New York. Stock of Strong & Backus, Colchester.

ANALYSES.

	1892	1945	1951	1952	2137	2138
Potash	27.17	25.03	26.34	26.82	26.34	26.08
Equivalent Sulphate of Potash	50.2	46.3	48.7	49.6	48.7	48.2
Chlorine	----	1.88	1.80	1.80	----	----
Cost per ton	$30.00	37.00*	----	----	----	35.00
Potash costs per pound, cts.	5.5	7.3	----	----	----	6.7

* $35.00 f. o. b. in N. Y.

MURIATE OF POTASH.

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), 15 per cent. or more of common salt (sodium chloride), and 4 per cent. or more of water. It is generally retailed on a guarantee of 80 per cent. muriate, which is equivalent to 50.5 per cent. of actual potash.

1928. Sold by H. J. Baker & Bro., New York. Stock of R. B. Bradley & Co., New Haven. Dealer declined to quote retail price.

2140. Sold by H. J. Baker & Bro., New York. Stock of C. O. Jeliff & Co., Southport.

1943. Sold by H. J. Baker & Bro., New York. Stock of Dennis Fenn, Milford.

2141. Sold by the Mapes Branch, Hartford.

1944. Sold by C. Meyer, Jr., Maspeth, Long Island. Stock of G. F. Platt, Milford.

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* Epsom salt is crystallized hydrated sulphate of magnesia, with 51 per cent. water of crystallization.

2062. Sold by Quinnipiac Fertilizer Co., New London. Stock of Wilson & Burr, Middletown.

1890. Sold by L. Sanderson, New Haven. Sampled in February.

2121. Sold by L. Sanderson. Sampled in September.

1953. Sold by National Fertilizer Co. Stock of Mattabesett Grange, Middletown.

2139. Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

ANALYSES.

	1928	**2140**	**1943**	**2141**	**1944**	**2062**	**1890**	**2121**	**1953**	**2139**
Potash	51.17	51.67	50.40	53.73	51.77	48.85	50.88	51.33	52.95	51.27
Equivalent Muriate of Potash	80.8	81.9	79.7	84.9	82.0	77.2	80.6	81.4	83.9	80.9
Cost per ton, $		42.00	45.00	45.00	43.50	42.50	42.50	41. 0	....	....
Potash costs per pound, cts.		4.1	4.4	4.2	4.2	4.4	4.2	4.0	....	....

Muriate of potash is generally sold in the same packages in which it is received from Germany, or is merely rebagged by importers without manipulation. The differences in composition are due in part to variations in the freshly manufactured article, and in part to accidents in shipment.

KAINIT.

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. It also usually contains more water than the sulphate or muriate of potash. It is usually sold on a guarantee of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It cannot properly be called or be used as a sulphate of potash, because it contains more than enough chlorine to combine with all the potash present and there is every reason to believe that its potash exists as muriate and not as sulphate.

1929. Sold by H. J. Baker & Bro., New York. Stock of C. O. Jeliff & Co., Southport.

2147. Sold by Quinnipiac Co., New London. Stock of E. A. Godfrey, Southport.

1913. Stock of L. Sanderson, New Haven.

1955. Sold by National Fertilizer Co., Bridgeport, to Meriden Grange.

2148. Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

ANALYSES OF KAINIT.

	1929	2147	1913	1955	2148
Potash	12.41	12.82	12.26	12.42	13.07
Cost per ton	$13.00	12.00	11.50	....	....
Potash costs per pound, cts.	5.2	4.7	4.7	....	....

COTTON HULL ASHES.

1924. From stock of W. W. Cooper and E. A. Russell, Suffield. Sampled by Station Agent.

1896. Sampled and sent by Dwight S. Fuller, Suffield. Received by him from Mr. Charles, New Orleans, La.

1899. From Stock of F. C. Harmon. Sampled and sent by Edmund Halladay, Suffield.

1926. Mixture of three samples from stock of J. Fröhlinger, E. A. Russell and F. E. Granger, all of Suffield. These lots were all bought of F. C. Harmon, Suffield.

1950. From stock of Olds & Whipple, Hartford. Sampled and sent by C. H. Cables, Thomaston.

1962. From stock of Olds & Whipple, Hartford. Sampled and sent by L. G. Goodrich, Simsbury.

1979. From stock of R. A. Parker, Warehouse Point. Sampled and sent by John Mason, Warehouse Point.

1923. From stock of R. E. Pinney, Suffield. Sampled and sent by C. D. Woodworth, Thompsonville.

1925. Mixture of two samples. One from stock of R. E. Pinney, the other from stock sold by him to E. A. Russell, Suffield. Sampled by Station Agent.

1963. From stock bought by H. B. Wakeman, Greens Farms, of American Oil Co., of New York. Sampled and sent by Station Agent.

COTTON HULL ASHES—ANALYSES AND VALUATION.

	1924	1896	1899	1926	1950	1962	1979	1923	1925	1963
Soluble Phosphoric Acid	1.72	1.57	.91	.51	1.65	.64	.40	.75	2.08	1.44
Reverted Phosphoric Acid	6.44	7.63	4.00	5.15	7.06	6.78	6.78	5.67	6.90	6.33
Insoluble Phosphoric Acid	.74	1.42	.09	.96	2.40	1.42	1.77	1.51	1.85	.59
Potash Soluble in Water	12.54	18.97	32.79	28.58	21.54	27.72	21.43	20.91	21.36	26.73
Cost per ton	$35.00	35.00	33.00	33.00	35.00	....	35.00	35.00	35.00	30.00
Valuation per ton	26.50	35.39	43.57	40.36	37.88	42.25	35.09	33.30	37.92	41.44

Soluble phosphoric acid in the ashes is valued at 8 cents per pound, reverted at 7½ cents and insoluble at 2 cents per pound. The potash being free from chlorides is valued at 5½ cents. As in past years the ashes vary greatly in composition, but are an excellent source of potash, especially for tobacco growers. The ashes sold by the American Oil Co. and by R. E. Pinney are in good condition mechanically, being free from the large hard lumps which are common in crude cotton hull ashes.

CAYUGA LAND PLASTER.

1947. Made by Cayuga Plaster Co., Union Springs, New York. Sampled by H. J. Mattoon, Watertown., from stock sold by him. Cost $7.00 per ton.

Pure Hydrated Sulphate of Lime	66.50
Sand and Insoluble Matters	6.27
Other Matters, chiefly Carbonate of Lime	27.23
	100.00

The sample has about the average composition of Cayuga Plaster, which usually differs from Nova Scotia Plaster chiefly in containing a larger quantity of carbonates.

UNLEACHED HARDWOOD ASHES.

1910. Sold by Charles Stevens, Napanee, Canada. Stock of T. R. Dawley, Griswold.

2084. Sold by Charles Stevens. Sampled from stock at Shaker Station.

2135. Sold by Charles Stevens, Napanee, Canada. From stock bought by Augustus Meeker, Southport, and sampled and sent by him.

1897. Sold by James Hartness, Detroit, Mich. Sampled by W. H. Burr, Westport.

2134. Sold by E. M. Jennings, Southport. Sampled and sent by Augustus Meeker, Southport.

2152. Sold by Irwin Jennings. Sampled and sent by E. O. Wakeman, Westport.

	1910	**2084**	**2135**	**1897**	**2134**	**2152**
Water	11.99	---	---	10.84	---	---
Phosphoric acid	1.61	1.38	1.56	1.66	1.44	.98
Potash soluble in water	7.67	5.58	7.01	5.34	4.96	4.95
Sand and soil	9.05	---	---	15.40	---	
Cost per ton	$12.00	15.00*	11.50*	11.00	11.50*	

Lime Kiln Ashes.

2012. Made in New York State. From E. M. Jennings, Southport.

Phosphoric acid	1.66
Potash	1.24
Sand and soil	5.40
Coal, etc.	2.80
Water	22.45

* In car lots.

Corn Cob Ashes.

1886. Sampled and sent by W. W. Pease, Thompsonville.

Potash soluble in water	12.87
Phosphoric acid	2.26
Sand, soil and coal	34.65

Cost $25 per ton.

The agricultural value of ashes generally depends not merely on the quantity of potash and phosphoric acid they contain, but also consists in their favorable effect on the mechanical condition of the soil, and especially in their serving to supply lime to the soil and to the crop, in the form of carbonate.

Analysis of Tobacco Stalks, No. 1895.

On the 17th of February, Mr. Byron Loomis brought to this Station a sample of Tobacco Stalks, in regard to which he stated as follows:—The stalks are from Havana Seed Tobacco raised in Suffield, planted in rows 3½ feet apart, the plants 18–20 inches apart in the row. The sample represents 50 average stalks after they have been cured, and weighs 20 pounds. From Mr. Loomis's statement it appears that there were between 7100 and 7900 stalks to the acre or 7500 on the average, and accordingly their weight at the date would be about 3000 pounds or 1½ tons to the acre. The analysis follows, and for comparison is also given an analysis of stalks of Connecticut Leaf, Havana Seed, Tobacco, which were supplied to the Station by Mr. H. H. Austin, of Suffield. The analysis, with a different water content is found on page 105 of the Report for 1884. Mr. Austin's sample was much drier than Mr. Loomis's sample, containing only 45.90 per cent. of water. The analysis is here reckoned to 67.00 per cent. of water for comparison. Mr. Austin also estimates the weight of the [drier] stalks at 4000 pounds per acre. These differences in estimated total yield and in the water-content of the stalks account largely for the difference in the yield of plant food per acre as calculated from the analysis.

	Mr. Loomis's Sample.	Mr. Austin's Sample.
Water	66.99	67.00
Organic and Volatile Matter	29.96	30.06
Containing Nitrogen	[.69]	[.13]
Ash or Mineral Matter	3.05	2.94
	100.00	100.00

The mineral matter contains:

	Mr. Loomis's Sample.	Mr. Austin's Sample.
Potash	1.37	1.60
Soda	.02	.01
Lime	.29	.30
Magnesia	.15	.19
Oxide of Iron	.04	--
Phosphoric acid	.18	.22
Sulphuric acid	.16	.23
Chlorine	.34	.33
Sand and Silica	.58	.13
	3.13	3.01
Deduct oxygen equivalent to chlorine	.08	.07
	3.05	2.94

From the data given by Mr. Loomis the amount of plant food contained in the stalks, furnished by him is calculated as follows, for the produce of an acre:

Nitrogen	20.6	pounds.
Phosphoric acid	5.4	"
Potash	41.0	"
Soda	.5	"
Lime	7.8	"
Magnesia	4.4	"
Sulphuric acid	4.7	"
Chlorine	10.3	"

The stalks therefore contain about as much nitrogen and potash as would be furnished by an application of 70 pounds of muriate of potash and 300 pounds of cotton seed meal per acre. The latter would, however, contain nearly twice as much phosphoric acid.

MUCK FROM FLORIDA.

The two following analyses were made in the interest of citizens of Connecticut, who are engaged in orange culture in Florida. Under date of July 14, Mr. Cyrus Pickett of New Haven, writes in regard to the samples: "No. 1 consists of rotted leaves and plants in what are called "Bays," that cover millions of acres in Florida. No. 4 is from "Ponds" that are really a kind of muck or peat beds into which you can press a pole ten or fifteen feet sometimes.

"Is it true that there are acids in them that do as much hurt to orange trees as the valuable elements do good?"

The results of analysis were as follows:

2104. Muck from "Bays" in Florida, No. 1.

2107. Muck from "Ponds" in Florida, No. 4.

Station No.	**2104**	**2107**
Water	13.90	6.19
Organic and volatile matter*	70.82	37.50
Ash	15.28	56.31
	100.00	100.00
* Containing nitrogen	1.67	1.26
The ash is made up of:		
Sand and soil	12.75	54.20
Iron Oxide	trace	trace
Lime	.38	.18
Magnesia	.68	.49
Phosphoric acid	.18	.19
Other matters not separately determined	2.29	1.25
	16.28	56.31

2104 has a faintly acid reaction. No soluble iron salts.

2107 has a faintly acid reaction. There is a bare trace of soluble iron salts.

To Mr. Pickett was written substantially as follows:

"The analyses represent the peat in a comparatively dry condition. No. 1 is much richer in vegetable matter than No. 4, has therefore more nitrogen and is probably the more valuable agriculturally. On the dry sandy lands near the deposits these mucks will prove a valuable amendment, making the soil more retentive of moisture and at the same time richer in plant food. The peat should be thrown out to dry some time before it is to be used so as to give it time to weather and become crumbly and mellow. If horse manure, urine or old fashioned guano are at your disposal, composting the peat with either of these things will much improve it. At present the nitrogen in the peat is no doubt mostly in an inert form and composting will make it more readily available."

It may be added that the "injurious acids" of peat or swamp muck commonly consist of acid salts of iron or alumina which are rendered harmless by exposure to air and rain and by composting with animal manures or with lime.

REVIEW OF THE FERTILIZER MARKET

For the Year ending Dec. 1, 1887.

Nitrogen.

Organic Nitrogen.

The nitrogen of *Dried Blood* was quoted *at wholesale* in the New York market in December, 1886, at about 13.3 cents per pound. It rose to 13.6 cents in April, which was the highest figure for the year, declined to 13.1 cents in June, 12.6 cents in August and 12.1 cents in September.

The *wholesale* quotation of nitrogen in *azotin* has ruled somewhat higher, 14.5 cents in December of last year, 14.1 in April, 13.4 in August and 12.3 in October.

The wholesale cost of organic nitrogen the year through has been considerably under 14 cents per pound.

The *retail price* of the nitrogen of dried blood in three samples form the Connecticut market has been from 14.6 to 17 cents per pound. It is sold in New Haven at 17 cents per pound at this time (Dec. 1). Castor Pomace has been freely sold in the State this season at prices which make its nitrogen cost a trifle over 14 cents.

Nitric Nitrogen.

The *wholesale* price in the New York market of nitrogen in *Nitrate of Soda* was 13.1 cents per pound in December of last year. It rose in February to 13.6, in March to 14.3, and in April to 14.9. It then gradually declined to 11.8 cents in August, rallied in the next two months to 13.0 and is now quoted at 12.7.

Its *retail* price in this State has been from 16.4 to 18.7 cents per pound. It is offered freely at 17 cents.

Ammonic Nitrogen.

The *wholesale* price in New York of nitrogen in *Sulphate of Ammonia* has been quite constant, fluctuating between 14.5 and 14.9 cents during the entire year, the average price being about 14.6 cents.

The *retail* cost in this State has been from 17.1 to 18.3 cents.

PHOSPHATIC MATERIALS.

Refuse Bone Black stood at $18.50 per ton wholesale till September when it fell to $17.75.

Ground Bone at the same time fell from $29.50 to $28.50.

Ground Charleston Rock, f.o.b., N. Y., fell in September from $8.25 to $7.50 and in October to $6.25.

Sulphuric Acid, 66° fell in May from 1·17½ cts. per pound wholesale to 1.07½.

POTASH.

In Muriate of Potash.

Potash *at wholesale* in this form was quoted at the beginning of the year at 3.41 cents per pound. It rose in April to 3.56, declined in June to 3.41 again and in September to 3.36. Its *retail* price in the State has been from 4 to 4.4 cents per pound during the year.

In Double Sulphate of Potash and Magnesia.

Potash *at wholesale* in this form has sold at from 4.05 to 4.15 cents per pound in New York.

Its *retail* price in the State has been from 5.5 to 7.3 cents per pound. Apparently it is not retailed at nearly so close a margin as the muriate.

In Kainit.

The *wholesale* price of Kainit has been from $7.37 to $7.87 per ton. Assuming that Kainit averages 12.4 per cent. of potash the *wholesale* cost of actual potash in kainit has been from 3.0 to 3.17 cents per pound. The *retail* cost in the State has been from 4.7 to 5.2 cents per pound. Kainit at present prices is a less economical source of potash than muriate and so far as its potash goes is in no way superior to the muriate.

In general there has been no striking change in the wholesale fertilizer market during the year in the quotations of potash and phosphoric acid.

Nitrogenous matters, except sulphate of ammonia, have been noticeably cheaper than in the previous year.

The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged and this average is taken as the quotation for the month.

The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

Phosphate rock, *kainit*, *bone*, *fish-scrap*, *tankage*, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock and purchasers often control this by an analysis at the time of purchase.

Sulphate of ammonia, nitrate of soda and muriate of potash are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, azotin and ammonite are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen, multiply the per cent. of ammonia by the decimal .824 (or multiply the percentage of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $2.25 per unit, a ton of it will cost 8½ × 2.25 = $19.13.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given.

Ammonia at	$3.80	per unit	is equivalent to	nitrogen at	23.0	cts.	per lb.
"	3.70	"	"	"	22.4	"	"
"	3.60	"	"	"	21.8	"	"
"	3.50	"	"	"	21.2	"	"
"	3.40	"	"	"	20.6	"	"
"	3.30	"	"	"	20.0	"	"
"	3.20	"	"	"	19.4	"	"
"	3.10	"	"	"	18.8	"	"
"	3.00	"	"	"	18.3	"	"
"	2.90	"	"	"	17.6	"	"
"	2.80	"	"	"	17.0	"	"
"	2.70	"	"	"	16.4	"	"
"	2.60	"	"	"	15.8	"	"
"	2.50	"	"	"	15.2	"	"
"	2.40	"	"	"	14.6	"	"
"	2.30	"	"	"	14.0	"	"
"	2.20	"	"	"	13.4	"	"
"	2.10	"	"	"	12.8	"	"
"	2.00	"	"	"	12.2	"	"
"	1.90	"	"	"	11.6	"	"
"	1.80	"	"	"	11.0	"	"

Commercial Sulphate of Ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

At	4¾	cents per lb.	Nitrogen	costs	23.1	cents per lb.
"	4⅝	"	"	"	22.5	"
"	4½	"	"	"	21.9	"
"	4⅜	"	"	"	21.3	"
"	4¼	"	"	"	20.7	"
"	4⅛	"	"	"	20.1	"
"	4	"	"	"	19.5	"
"	3⅞	"	"	"	18.9	"
"	3¾	"	"	"	18.3	"
"	3⅝	"	"	"	17.6	"
"	3½	"	"	"	17.0	"
"	3⅜	"	"	"	16.4	"

At	3¼	cents per lb.	Nitrogen	costs	15.8	cents per lb.
“	3⅛	“	“	“	15.2	“
“	3	“	“	“	14.6	“
“	2⅞	“	“	“	14.0	“
“	2¾	“	“	“	13.4	“

Commercial Nitrate of Soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

If quoted at	3⅜	cents per lb.	Nitrogen	costs	21.5	cents per lb.
“	3¼	“	“	“	20.8	“
“	3⅛	“	“	“	19.9	“
“	3	“	“	“	19.2	“
“	2⅞	“	“	“	18.3	“
“	2¾	“	“	“	17.6	“
“	2⅝	“	“	“	16.9	“
“	2½	“	“	“	16.0	“
“	2⅜	“	“	“	15.2	“
“	2¼	“	“	“	14.4	“
“	2⅛	“	“	“	13.6	“
“	2	“	“	“	12.8	“
“	1⅞	“	“	“	12.0	“
“	1¾	“	“	“	11.2	“

Commercial Muriate of Potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

If quoted at	2.00	cts. per lb.	Actual Potash	costs	3.96	cts. per lb.
“	1.95	“	“	“	3.86	“
“	1.90	“	“	“	3.76	“
“	1.85	“	“	“	3.66	“
“	1.80	“	“	“	3.56	“
“	1.75	“	“	“	3.46	“
“	1.70	“	“	“	3.36	“
“	1.65	“	“	“	3.26	“
“	1.60	“	“	“	3.16	“
“	1.55	“	“	“	3.06	“
“	1.50	“	“	“	2.96	“

The Double Sulphate of Potash and Magnesia usually has about 26½ per cent. of actual potash.

If quoted at	1.00	ct. per lb.	Actual Potash	costs	3.77	cts. per lb.
“	1.05	cts. “	“	“	3.96	“
“	1.10	“	“	“	4.15	“
“	1.15	“	“	“	4 34	“
“	1.20	“	“	“	4.53	“

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since April, 1884. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt.

		COST OF NITROGEN AT WHOLESALE IN				COST OF POTASH AT WHOLESALE IN
		Blood. cts. per lb.	Azotin or Ammonite. cts. per lb.	Nitrate of Soda. cts. per lb.	Sulphate of Ammonia. cts. per lb.	Muriate of Potash. cts. per lb.
1884.	April	13.6	13.6	14.0	14.6	3.38
	May	14.0	13.9	14.4	15.3	3.44
	June	13.9	13.5	13.8	14.6	3.36
	July	13.2	13.5	14.2	14.9	3.37
	August	13.6	13.3	14.3	14.7	3.36
	September	12.8	13.3	14.4	14.4	3.28
	October	12.9	13.2	14.3	14.8	3.38
	November	12.4	12.6	14.4	15.2	3.26
	December	12.1	12.8	14.4	15.2	3.32
1885.	January	12.3	13.0	14.1	15.2	3.32
	February	12.6	13.4	14.4	15.2	3.36
	March	13.4	13.7	13.2	15.2	3.58
	April	13.6	13.7	13.2	15.2	3.51
	May	14.3	13.7	14.1	15.2	3.54
	June	13.9	13.7	14.0	15.2	3.36
	July	13.6	13.6	14.0	15.0	3.31
	August	13.8	13.6	15.0	14.9	3.34
	September	13.4	13.5	15.6	14.8	3.36
	October	13.4	13.5	16.0	14.8	3.36
	November	13.8	13.5	15.6	14.8	3.38
	December	14.1	13.9	16.0	14.9	3.39
1886.	January	14.0	14.2	15.6	15.1	3.38
	February	14.2	14.3	15.2	15.2	3.46
	March	14.9	14.7	16.0	15.8	3.64
	April	14.9	15.7	16.1	16.4	3.56
	May	14.6	15.4	16.4	15.8	3.41
	June	13.9	14.7	15.6	14.6	3.32
	July	14.2	14.4	14.9	14.6	3.31
	August	14.1	14.4	14.0	14.5	3.31
	September	14.1	14.4	13.7	14.4	3.40
	October	14.4	14.4	13.2	14.6	3.41
	November	14.0	14.4	12.7	14.7	3.41
	December	13.3	14.5	13.1	14.7	3.41
1887.	January	13.3	14.5	13.0	14.6	3.41
	February	13.5	14.5	13.6	14.6	3.41
	March	13.4	14.5	14.3	14.5	3.51
	April	13.6	14.1	14.9	14.5	3.56
	May	13.4	14.0	14.7	14.5	3.48
	June	13.1	14.0	14.0	14.5	3.41
	July	13.1	14.0	12.0	14.5	3.41
	August	12.6	13.4	11.8	14.5	3.40
	September	12.1	12.5	12.2	14.7	3.36
	October	12.1	12.3	13.0	14.9	3.36
	November	11.8	12.2	12.7	14.7	3.41

On the Valuation of Tankage.

Tankage has been valued like bone, with due regard to its mechanical as well as its chemical analysis, as explained on page 29, on the assumption that both the fine and coarse particles have the same composition. A possible objection to this method is that the nitrogenous matter of tankage may be much finer than the bone fragments which have been largely freed from their nitrogenous constituents by boiling. If so, then the system undervalues the nitrogen and overvalues phosphoric acid, making the total valuation lower than it should be. To test the matter, two samples of tankage, one of eastern, the other of western manufacture, were separated by sieves into the several grades as practiced in the mechanical analysis of bone, nitrogen and phosphoric acid were separately determined in each portion, and the valuation of each grade was reckoned by the schedule as on page 27. The total valuation thus obtained, free from the objection cited above, could then be compared with the valuation made in the usual way. The results are tabulated on the following page and are so nearly identical as to show that the method of valuation commonly used for bone is equally applicable to tankage.

ANSWERS TO CORRESPONDENTS CONCERNING FERTILIZERS.

Preparation of Bone Superphosphate.

In answer to repeated inquiries from various sources, the methods of "dissolving" ground bone, i. e. of preparing a bone superphosphate by help of sulphuric acid—useful where soluble phosphoric acid and nitrogen are desired—is here reproduced from the Report of this Station for 1881.

"Most of the ground bone that comes into market contains a considerable proportion of coarse fragments which may remain in the soil for years before they become of avail to plants. The finest parts of ground bone are, on the other hand, adapted to feed crops at once. If ground bone be treated directly with sulphuric acid, the fine parts are promptly decomposed, but the coarse portions are but little acted on unless a large amount of acid and much time are consumed. Dr. Alexander Müller has proposed the following very rational method of treating ground bone, which is perhaps the best adapted for domestic use of any of the processes involving the use of oil of vitriol.

TANKAGE.

		Mechanical Analyses.		Chemical Analyses.			
		1889	1891	1889		1891	
		Western Tankage.	New York Tankage.	Western Tankage.		New York Tankage.	
				Nitrogen.	Phos. Acid.	Nitrogen.	Phos. Acid.
Fine,	smaller than $\frac{1}{50}$ inch	67	73	7.04	13.01	5.54	18.74
Fine-medium,	" $\frac{1}{25}$ "	20	13	7.90	11.19	5.57	18.04
Medium,	" $\frac{1}{12}$ "	12	10	8.22	10.56	4.05	23.54
Coarse-Medium,	" $\frac{1}{6}$ "	1	4	9.07	....	2.17	31.91
		100	100				

The Valuations per ton were:—

	1889 Western Tankage.	1891 New York Tankage.
By the usual method	$38.60	$41.87
By the special method above described	38.28	41.44

Take 100 lbs. of ground bone such as contains 20 to 50 per cent., more or less, of material coarser than ¼ inch, 25 lbs. of oil of vitriol of 66°, the strongest commercial acid, and six quarts of water.

Separate the bone by sifting into two, or if the proportion of coarse bone is large, into three parts, using sieves of $\frac{1}{16}$ inch and $\frac{1}{8}$ inch mesh.

Mix the coarser part of the bone in a cast-iron or lead-lined vessel or in the half of an oil barrel with the oil of vitriol. When the bone is thoroughly wet with the strong acid, add the water, stirring and mixing well. The addition of the water to the acid develops a large amount of heat which favors the action. Let stand, with occasional stirring, for twenty-four hours, or until the coarsest fragments of bone are quite soft ; then, if three grades of bone are used, work in the next coarser portion of bone, and let stand another day or two until the acid has softened all the coarse bone, or has spent its action ; and finally, dry off the mass by mixing well with the finest bone. In carrying out this process, the quantity of oil of vitriol can be varied somewhat—increased a few pounds if the bone has a large proportion of coarse fragments, or diminished if it is fine.

Stöckhardt gives a somewhat different procedure, viz: " From a mixture of sifted wood or coal ashes and earth thrown upon a barn or shed floor, form a circular wall so as to enclose a pit capable of containing one hundred weight of ground bone ; the surrounding wall of ashes may be rendered so firm as not to yield by being trodden down or beaten firm with a board.

Sift off the finer part of the bone and set it aside. Throw the coarser part into the cavity, and sprinkle it during continued stirring with three quarts of water until the whole is uniformly moistened; add gradually eleven pounds of oil of vitriol of 66°, the agitation with the shovel being continued. A brisk effervescence of the mass will ensue (from decomposition of the carbonate of lime in the bones), which will not, however, rise above the margin of the pit if the acid is poured on in separate small quantities. After twenty-four hours, sprinkle again with three quarts of water, add the same quantity of sulphuric acid as before, with the same brisk shoveling of the mass, and leave the substances to act for another twenty-four hours upon each other. Then intermix the fine bone previously sifted off, and finally shovel the ashes and earth of the pit into the decomposed bone until they are all uniformly mixed together."

Treating Bones with Acid.

"Will you inform me if there is any fertilizing property in sulphuric acid or is it only used to cut bone, in the manufacture of superphosphate? I inclose formula for making phosphate that I have taken from my scrap book and ask your opinion of it."

To these questions was replied substantially:

Sulphuric acid is a plant-food but is not generally deficient in our soils. It can be most economically supplied in land plaster which is the sulphate of lime. You ask an opinion as to the inclosed formula. *Fine* bone dust needs no "cutting" with acid to make it readily available for crops. If you do cut it with acid it will usually be necessary to add a drier like the dry loam or wood dirt of your formula, else the mass will be smeary or pasty. If you want a more quickly acting phosphate it would probably be cheaper to buy plain bone-black superphosphate [at $28.00 a ton] and mix one or two hundred pounds to the ton with your bone meal rather than experiment with sulphuric acid which is a somewhat dangerous thing for one unskilled in its use to handle.

The cost of hauling of 1600 pounds of loam from and to the fields will go far towards the purchase of a small proportion of superphosphate.

The best methods of "cutting" bones with sulphuric acid are given on a previous page.

Dissolving Bone, Composting Offal, etc.

A correspondent inquires in substance as follows:

1. Is the phosphoric acid of steamed bones available?

2. What quantity of acid is it best to use to cut steamed bones?

3. Is it necessary to treat fish with acid in order to make a good fertilizer of them?

4. What is the value of nitrate of potash as a fertilizer?

5. Having refuse meat and offal from a slaughter at my disposal what quantity of muck must I use with it to make compost equal to horse manure and how shall I manage the composting?

Answer.

"1. Doubtless all the phosphoric acid of steamed bone is readily available, not so quickly as that of bones "dissolved" in acid, but quickly enough for all practical purposes, especially if the steaming has been done under high pressure so that the bones are easily crushed to powder.

2. The amount of acid advantageous to use for raw bones you will find stated on page 93 of this Report—Dr. Alexander Müller's method. Steamed bones, if they require acid to subdivide them may be treated in the same manner.

3. It is not needful to treat fish with acid at all in order to make a good fertilizer. To prevent the loss of ammonia, and to suppress stink and destroy flies and maggots it pays to sprinkle the fresh fish-scrap with a few per cent. of diluted oil of vitriol. That makes the bones so friable that they crush easily to powder and mostly converts them into superphosphate.

4. Nitrate of potash is excellent as a fertilizer but costs too much. It is cheaper to use nitrate of soda and muriate of potash together.

5. It is not easy to say how much muck to one of meat will make a compost just equal to horse-manure. I should use muck or leaf mold as dry as possible and use with the meat muck enough to take up the water and leave a nearly dry mass. If needful to make it dry I would add sifted dry coal ashes or wood ashes and I would mix in a good sprinkling of plaster or sulphate of potash. The mixture thus made should be protected from wet and allowed to heat moderately. Then to regulate the heating and prevent loss it should be trodden or stamped down. If that does not suffice, it should be sprinkled with water till moist and packed or stamped more, or the proportion of muck should be increased. These directions are very general but if you will set up several trial heaps, noting carefully what quantities of materials you use and observing that the mixtures should decompose and heat within a reasonable time but should suffer no loss of ammonia [perceptible to the smell] you will soon understand the matter. The Station will assist you by analyses of materials and products on condition that results may be published for the benefit of the public."

COPPERAS AS A FERTILIZER.

A correspondent writes:—

"The Journal of the Chemical Society states that copperas is a valuable dressing for many crops; that one-eighth of an acre with fourteen pounds applied yielded 5278 pounds of potatoes, an increase of 400 pounds over a similar plot not so treated; also recommends it for other crops—hay was doubled in quantity by its use—and so forth.

I would like to ask you what fertilizing material it contains and whether the statement seems reasonable enough to warrant making the experiment. I think it will cost about three cents per pound by the barrel. I expect to use some this year to protect grape-vines from rot and mildew. As it has a sterilizing effect on fungi I should infer that it might act injuriously on the growth of agricultural plants."

Answer.—The statement by A. B. Griffiths in the Journal of the Chemical Society to which you refer gives account of some remarkable results from the use of copperas (protosulphate of iron) on various crops. He found that there was less increase of yield in case of the cereals than with root crops. But he claims that copperas prevents or hinders mildew on wheat and that in very weak solution (one part by weight in one thousand of water), it destroys the spores of mildew; which is remarkable because most spores are very retentive of life. On mossy land Griffiths observed that it destroyed moss and increased the grass crop. All this seems to have been accomplished with very moderate applications, only one-half a cwt. (fifty-six pounds) per acre. Sir J. B. Lawes is quoted as saying that in his experience 1½ cwt. was rather too much to apply per acre. Griffiths' explanation of the favorable effect of copperas is that it increases the chlorophyl in the leaves, of which iron is an essential constituent, and so increases the power of the plant for assimilation. He finds a larger percentage of fiber, of carbhydrates and of nitrogen, in crops raised with an application of copperas than in those produced on the same kind of soil without it, which facts he cites as sustaining his hypothesis. But since the soil itself with which he experimented contained 3·95 per cent. of sesquioxide of iron, it is difficult to believe that it could not furnish as much assimilable iron as his application of fifty-six pounds per acre of copperas. The iron of the soil is, however, in all ordinary cases very slowly and slightly soluble; in some soils a supply of freely soluble iron may be of great advantage to crops. It was demonstrated that the observed increase of crop was not due to a supply of sulphuric acid by the copperas because kainit and superphosphates containing abundance of sulphuric acid, proved to have less effect.

The results are scarcely to be explained by the indirect action of the salt in making plant-food soluble in the soil-water, for kainit, which would be supposed to exert such effect, did not give nearly so large a yield as the copperas. It is probable that in the soil on which Griffiths operated there were certain fungi or bacteria which had an unfavorable effect on crop-production and that copperas was beneficial chiefly or wholly on account of its property of destroying or sterilizing these organisms. Kellner in experiments on small plots of ground in Japan with from 50 to 600 pounds of copperas to the acre found no good effect and no injury from its use. König, in Germany, observed an increase of crop in some trials made in this way.

I know of but one experiment in this country with copperas, made by G. H. Whitcher at the New Hampshire Agricultural College Farm, and reported in "Agricultural Science." To one quarter of an acre of land was applied broad-cast, 70 pounds of dissolved bone black, 30 of muriate of potash and 10 of sulphate of ammonia, and in the hill 35 pounds of dissolved bone black, 15 of muriate of potash and 8 of copperas. To another adjoining quarter-acre plot were added the same fertilizers in the same way but omitting the copperas. Both plots were planted to maize. That which had copperas produced a rank growth of dark green color. The harvest was as follows:

	Sound Corn.	Soft Corn.	Stover.
One-fourth acre with chemical manures and copperas,	820	110	1000
One-fourth acre with chemical manures without copperas,	670	170	970
Gain or loss.	+ 150	— 60	+ 30

Thirty-two pounds of copperas per acre increased the yield of corn 600 pounds, or 22 per cent.

In Europe many trials with sulphate of iron, sulphate of soda, sulphate of magnesia, common salt, chloride of calcium, chloride of magnesium and various other saline compounds were on record thirty or forty years ago and instances were not wanting in which crops improved in appearance and increased in quantity by such applications.

Trials with copperas being inexpensive, are well worth making, though to judge from past experience this substance will not be found generally helpful. It will be injurious to agricultural plants when applied in too large quantities; even in small quantity it may prove a damage on "sour," that is, close-textured and wet land. It might be found of advantage, if any where, on rich garden land that has had abundance of stable manure applied for many years.

Superphosphate from Bone.

A correspondent asks:

1. What quantity of acid is necessary to dissolve 100 pounds of bone?

2. What strength of acid is most suitable?

3. What will be the percentage composition of a superphosphate made from bone?

4. What will be the mechanical condition of the superphosphate?

Answer was made as follows:—

1. As to proportion of sulphuric acid to bone. This may properly vary somewhat since commercial "bone" itself is not constant in composition. Its phosphoric acid varies from 19 to 30 per cent. and its nitrogen from 6 to 2·5 per cent., usually the more phosphoric acid, the less nitrogen; and *vice versa.* The age of the bone [or of the animal] the time it has been weathered, boiled or dried, the amount of meat, tendon, marrow and sand adhering to it, all influence its composition.

Some twenty-five years ago Prof. J. T. Way, then chemist to the Royal Agricultural Society of England, stated that 100 pounds of average bone require 29 pounds of strong oil of vitriol [66° acid] to render the phosphoric acid all soluble, but as the organic tissue of the bone absorbs the sulphuric acid, sponge fashion, some excess of oil of vitriol, 35 to 40 pounds per 100 of bone, must be used for complete conversion of the phosphoric acid into a form soluble in water.

2. The strength of sulphuric acid to be used.

If oil of vitriol of 66° be used, it should be diluted with about one-half its weight of water. A corresponding quantity of "chamber acid" may be used.

3. Way states that 100 pounds of bone and 29 pounds of 66° acid should give a product of which 100 pounds contain,

Water	10
Animal matter	27 with 1·25 nitrogen.
Hydrated sulphate of lime	39
Superphosphate of lime	24 with 17 soluble phosphoric acid.

In practice, however, all the phosphoric acid is not made soluble.

4. Pure bone-superphosphate will be an unmanageable paste if enough sulphuric acid be used to make nearly all its phosphoric acid soluble. There is agriculturally no gain in making all the phosphoric acid of bones soluble in water. Fine bone is of itself a quick fertilizer requiring no treatment with oil of vitriol, so that the most economical result is attained by acting on the coarser parts of ground bone with sulphuric acid, and using the fine bone as a dryer.

An account of the method of dissolving bone is given on page 93.

VALUE OF WASTE LYE FROM SOAP WORKS.

To an inquiry on this subject, referred to the Station, reply was made as follows, after obtaining and analyzing a sample.

The analysis of the waste lye is as follows:—

Nitrogen	·04
Potash	·03
Soda	5·34
Water	88·79
Carbonic Acid, with small amounts of Chlorine, Sulphuric Acid and undetermined matters, by difference	5·80
	100·00

The analysis fully confirms the view that the waste of soap works is now-a-days essentially destitute of plant-food. This sample contains soda corresponding to 12·3 per cent. of sodium carbonate. Since in the analysis, soda and carbonic acid, etc., amount to but 11·1 per cent. there is evidently a small amount of caustic soda remaining in the lye. Speaking in general terms, carbonate of soda cannot be recommended as an application to land. There are indeed cases where it may do good, as experience has shown. Soil that is rich in vegetable matter, either that of drained swamp-land, or of fields and gardens that have been heavily dressed with stable manure, may be benefited and are least likely to be harmed, by its use. Its action on such soils is indirectly to feed the crops by favoring the conversion of the inert nitrogen of the vegetable matter into soluble and available forms. If applied directly to the land, the lye should be diluted with 10 to 20 times its bulk of water. The best use to make of this lye would be in composting and rotting swamp-muck or coarse vegetable refuse.

ANALYSES OF FEEDING STUFFS.

In former reports extended explanations concerning the Analysis, Valuation and Economical Use of Feeding Stuffs have been given. It is not thought necessary to repeat them here since copies of Reports containing them can be supplied to any who desire such explanations.

Twenty-two Samples of Feeding Stuffs * have been analyzed during the year 1887. Those which have general interest are here noticed.

HAY.

CCXLVIII. Rather coarse Clover Hay, baled. Bought in New Haven.

CCXLIX. Hay from mixed grasses, chiefly blue-grass (*Poa pratensis*) and fine bent (*Agrostis vulgaris*), cut on the Station land early when the blue-grass was in bloom.

ANALYSES.

	Baled Clover Hay. CCXLVIII.	Hay of Mixed Grasses. CCXLIX.
Water	15.11	20.25
Ash	3.17	4.68
Albuminoids	6.44	9.21
Fiber	29.77	22.92
Nitrogen-free Extract	4373	40.58
Fat (Ether Extract)	1.78	2.36
	100.00	100.00

SOME CONNECTICUT GRASSES.

In regard to these grasses Mr. J. B. Olcott of South Manchester kindly furnishes the following notes:

"The grasses whose analyses follow, with the exception of *Sorghum halapense*, Johnson grass,† are native grasses, growing with and without cultivation in our most productive meadows, as well as in neglected places, since the first settlement of the country. Farm testimony is abundant, but varying as to their value. Except that the foliage of several is injured by autumn frosts, their hardiness is unquestioned and even made a demerit by those who do not value *very* permanent meadow, wherein these deep-rooted and lasting grasses distinguish themselves. *Andropogon provincialis* (forked Andropogon, blue-stem of the west), has many strong friends, and this together with *Panicum virgatum* (black-bent), and *Chrysopogon nutans* (broad bent), must be considered worthy of close attention by investors in really permanent forage. Their seeding qualities and other practical points are not well known and cannot be ascertained in a single year's study. In the famous 'Hartford Meadows,' including the Windsors and Glastonbury, these, with other tall grasses in varying proportions, covering a finer growth of *Poa pratensis*, exist in park-like expanses of hundreds of acres, offering conclusive testimony of their worth to the State, and tempting investigation as to their more general value and uses.

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* Exclusive of potatoes.

† And perhaps of *Festuca ovina*.

Glyceria nervata prefers wet land (as the before-mentioned grasses do not), and makes seed freely. Of the lesser *Andropogons*, *scoparius*, prominent on Wallingford plains, is far better than bushes for forage. *Virginicus* is less prevalent than the other and less frequent in very dry land."

CCLXIII, *Glyceria nervata*, nerved meadow grass, cut in bloom in a wet spot by the road side in New Haven.

CCLXV, *Festuca ovina (?)*, sheep's fescue, cut in bloom under evergreen trees in a door yard in New Haven.

CCLXVI, *Panicum virgatum*, black-bent.

CCLXVII, *Andropogon provincialis*, blue-bent.

CCLXVIII, *Chrysopogon nutans.*

The last three samples were cut Sept. 9, in East Hartford meadows and brought to the station the same day by Mr. J. B. Olcott, who used all care that they should not dry out before their arrival. They represent rowen headed, but cut before bloom.

CCLXIX, *Andropogon scoparius*, broom grass, and

CCLXX, *Andropogon Virginicus ;* both cut by Mr. Olcott on his own land, Sept. 9, 1887, in condition like his other specimens but from poorer land owing to the vicinity of trees.

CCLXXI, *Panicum crus-galli var. hispidum*, barn yard grass. This was raised from seed—gathered the year before from a dumping ground in New Haven—planted in the Station Forage Garden. The seed was drilled in, Sept. 25, 1886, and did not come up that fall. The drill was replanted March 21, 1887. May 15 it came up, apparently from both fall and spring planting. Being a hot-weather grass it did not make great progress till July when it grew rapidly and stood five feet high and over, Sept. 5, when this sample was cut for analysis. The seed had formed but was not ripe. The seed was ready to gather the last week in Sept. The stalks at that time were greedily eaten clean by cows. This grass seems to be a surface feeder and filled the soil so completely with fine fibers that a hoe could scarcely be worked within a foot of the stalks. The seed of this grass is common enough in untidy potato fields in the fall and springing the next year is frequently cut for hay. Its qualities to be considered for that use are, quick and rank growth during July and August, besides being shallow-rooted and an annual and hence not troublesome in the following season if cut before seeding. It dries slowly and we do not recommend it for general use but regard it worthy of further trials here.

CCLXXVII, *Panicum agrostoides,* red top panic, cut at same place and time as CCLXX; common in the wetter portions of Hartford meadows.

CCLXXVIII, *Sorghum halapense*, Johnson grass. Cut in the Station Forage Garden, Sept. 5, 1887. The seeds had formed but were not ripe. This grass grew very thriftily but rusted badly about the time of blossoming. Sown in the late summer it is completely winter-killed and probably cannot survive the winter in this latitude.

As a standard of comparison the following table includes analyses of the dry substance of timothy hay—average of 53 analyses and of good meadow hay from mixed meadow grasses—average of 9 analyses.

A single analysis does not settle the value of a forage plant. Differences of soil, climate and season have a great effect on the chemical composition and feeding value of forage but these analyses are here given as a single contribution to our knowledge of their composition.

ANALYSES OF GRASSES.

Freshly Cut.

	Glyceria nervata. CCLXIII.	Festuca ovina (?) CCLXV.	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli var. hispidum. CCLXXI.	Panicum agrostoides. CCLXXVII.	Sorghum halapense. CCLXXVIII	Timothy Hay. 58 analyses	Hay from mixed meadow grasses. 9 analyses.
Water	74.88	71.85	65.16	73.09	67.01	57.08	64.50	80.52	65.01	68.62	----	----
Ash †	1.83	1.85	1.94	1.58	2.86	1.72	1.24	1.43	3.55	1.74	----	----
Albuminoids *	2.64	2.91	3.67	2.15	2.42	1.74	2.20	1.42	2.42	2.89	----	----
Fiber	8.41	9.98	10.40	8.51	9.96	16.21	13.03	6.75	10.44	9.37	----	----
Nitrogen-free Extract	11.75	12.68	17.99	14.05	17.00	22.64	18.30	9.54	17.93	16.44	----	----
Fat	.49	.73	.84	.62	.75	.61	.73	.34	.65	.94	----	----
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	----	----
Nitrogen	.42	.46	.58	.34	.38	.28	.35	.23	.38	.46	----	----
Phosphoric Acid	----	----	.15	.09	.19	.13	.13	.09	----	----	----	----
Potash	----	----	.20	.18	.36	.29	.28	.47	----	----	----	----

Water-free.

	Glyceria nervata. CCLXIII.	Festuca ovina (?) CCLXV.	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli var. hispidum. CCLXXI.	Panicum agrostoides. CCLXXVII.	Sorghum halapense. CCLXXVIII	Timothy Hay. 58 analyses	Hay from mixed meadow grasses. 9 analyses.
Ash†	7.29	6.57	5.57	5.87	8.67	4.01	3.49	7.34	10.14	5.54	**4.58‡**	**5.57‡**
Albuminoids *	10.39	10.25	10.53	8.18	7.35	4.06	6.21	7.32	6.94	9.20	**6.74**	**7.38**
Fiber	33.53	35.46	29.84	31.50	30.35	37.75	36.66	34.65	29.83	29.87	**33.82**	**36.79**
Nitrogen-free Extract	46.83	45.15	51.64	52.16	51.34	52.74	51.57	48.94	51.24	52.41	**52.50**	**47.85**
Fat	1.96	2.57	2.42	2.29	2.29	1.44	2.07	1.75	1.85	2.98	**2.36**	**2.41**
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	**100.00**	**100.00**
Nitrogen	1.68	1.63	1.67	1.26	1.15	.65	.98	1.18	1.11	1.47	----	----
Phosphoric Acid	----	----	.43	.34	.57	.30	.37	.46	----	----	----	----
Potash	----	----	.57	.67	1.09	.68	.79	2.41	----	----	----	----

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* The total nitrogen is here reckoned as albuminoids, by multiplying it by 6¼. On p. 104 it will be seen that in eight of the samples but from 68 to 88 per cent. of the nitrogen probably existed in the form of albuminoids, 12 to 32 per cent. occurring, for the most part, doubtless, in the state of "amides."

† Free from carbonic acid, water, and char.

‡ Probably crude ash.

As a further contribution to the knowledge of these grasses the mineral matter in them, "Ash," of the previous table, has been analyzed by Dr. Osborne. The results are as follows:*

COMPOSITION OF THE ASH OF GRASSES.

	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli, var. hispidum. CCLXXI.
Potash	10.53	11.13	12.29	17.01	23.61	33·47
Soda	1.99	.73	.87	.57	1.01	2.35
Lime	11.09	9.91	5.65	7.65	6.00	8·49
Magnesia	10.31	7.38	4.13	5.75	7.49	11.29
Oxide of Iron	.35	.25	.12	.46	.39	.85
Sulphuric Acid	4.74	2.66	1.28	2.51	2.64	11.48
Phosphoric Acid	7.62	5.55	6.35	7.82	11.23	6.53
Chlorine	.55	.78	.72	2.40	3.34	1.26
Silica and adher'g Sand	52.94	61.77	68.75	56.37	45.04	24.56
	100.12	100.17	100.16	100.54	100.75	100.28
Deduct Oxygen equivalent to Chlorine	.12	.17	.16	.54	.75	.28
	100.00	100.00	100.00	100.00	100.00	100.00

The "albuminoid" nitrogen, determined by Stutzer's method (Jour. für Landwirthschaft, 1881, p. 476. Report of this Station for 1885, p. 40), was as follows, in the air-dry substance.

	Panicum virgatum. CCLXVI.	Andropogon provincialis. CCLXVII.	Chrysopogon nutans. CCLXVIII.	Andropogon scoparius. CCLXIX.	Andropogon Virginicus. CCLXX.	Panicum crus-galli. CCLXXI.	Panicum agrostoides. CCLXXVII.	Sorghum. halepense. CCLXXVIII.
Total Nitrogen	1.53	1.17	1.08	.77	.91	1.10	1.02	1.35
"Albuminoid" Nitrogen	1.16	.87	.87	.60	.71	.75	.87	1.19
Per cent. of "Albuminoid" Nitrogen (Total Nitrogen=100.)	75.8	74.3	80.6	77.9	78.0	68.2	85.3	88.1

CONCENTRATED FOODS.

CCL. Beans. These were bought of a seedsman, being old stock and worthless for seed, but good feed for sheep.

CCLIX. Chicago gluten meal. Sold by Holmes and Keeler,

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* The analyses were made on the crude ash which contained some carbon. This was determined by drying silica and carbon together at 100° C., weighing and then igniting. Operating in this way the mixture of carbon and silica cannot be perfectly dried and for that reason the analyses came somewhat high, about 101 per cent. They are here reckoned free from carbonic acid, water and carbon.

Norwalk. Cost $21.00 per ton. Sent by D. H. Van Hoosear, Wilton.

DCLXII. "Corn-Germ Feed" from an Indianapolis Hominy Mill. Cost about $1.00 per 100 lbs. Sent by F. W. Holmes, Salisbury.

CCLX. Spring Wheat Bran and CCLXI. Winter Wheat Bran. Sent by S. D. Newell, Bristol.

ANALYSES.

	Beans. CCL.	Gluten Meal. CCLIX.	Corn Germ Feed. CCLXII.	Spring Wheat Bran. CCLX.	Winter Wheat Bran. CCLXI.
Water	15.00	8.23	12.18	10.90	11.13
Ash	3.10	1.27	2.54		
Albuminoids	20.37	27.38	10.87	15.19	14.06
Fiber	3.20	1.46	8.30		
Nitrogen-free extract	56.71	55.98	56.87		
Fat	1.62	5.68	9.24	4.85	4.47
	100.00	100.00	100.00		

Analyses of maize kernel and cob and of maize stalks will be found on pages 119 and 120 in the discussion of a field experiment and they need not be repeated here.

"IMPERIAL GRANUM."

CCLXXIX. as described by the proprietor, "Imperial Granum, The Great Medicinal Food. This justly celebrated dietetic preparation is in composition principally the gluten derived by chemical process from very superior growths of wheat. A solid extract. The invention of an eminent French chemist. It has acquired the reputation of being an incomparable aliment for the growth and protection of infants and children. The salvator for invalids and the aged," etc., etc.

ANALYSIS.

	Imperial Granum.	Wheat flour Average of 25 analyses.
Water	11.10	12.56
Ash	.33	.56
Albuminoids, including "gluten"	10.13	11.28
Fiber	.10	.27
Nitrogen-free extract	77.58	74.13
Fat	.82	1.20
	100.00	100.00
Cost per pound	$1.00.	$0.025—0.05

The "Imperial Granum" contains 77.24 per cent. of wheat-starch with possibly some dextrin. The quantity of dextrin and dextrose is not more than 1.8 per cent. The only wide difference between the figures given above for "Granum" and wheat flour is in the *cost per pound.* The "Granum" cannot be distinguished in chemical composition and properties from wheat flour slightly browned, which cooked as a porridge has long been used and prized as a food for infants and invalids.

It does not consist principally of the gluten of wheat, and is in no respect superior as food to good wheat flour.

"ANTI-FERMENTINE."

CCXLV. Made by W. W. Chase, Newburgh, N. Y. Sent by C. E. Sperry, Bolton. It is described by the manufacturer as follows: "Anti-fermentine is a simple, harmless preparation, free from taste, smell and color that has the property of stopping and preventing fermentation. * * * It is especially useful for preserving fruits of all kinds without cooking, retaining the natural fresh appearance and taste of the fruit. The question is sometimes asked: Is it injurious? To allay all doubts on that score we would say that we have consulted many of our most eminent chemists and physicians, and all unite in pronouncing the use of Anti-fermentine as a preservative a perfectly safe and harmless preparation, being composed of pure table salt and salicylic acid."

The composition of the article was as follows:—

Chlorine	19.87		
Equivalent salt		32.75	per cent.
Nitric acid	18.59		
Equivalent saltpeter		34.80	"
Salicylic acid (by difference)		32.45	"
		100.00	

The mixture consists accordingly of about equal weights of saltpeter, salt and salicylic acid. A single package contains about 50 grams or less than 2 ounces and costs 60 cents.

POTATOES.

A number of analyses of potatoes have been made at the request of Mr. Theron E. Platt of Newtown, who has made a specialty of growing potatoes and testing new varieties. The analyses with a single exception were made on samples kindly supplied by Mr. Platt. For table of analyses see page 108.

CCLXI. Home Comfort. First quality.

A. Variety unknown. Bought in New Haven.

CCXLVI. White Flower. Raised with 200 pounds sulphate of potash to the acre.

CCXLVII. White Flower. Raised with 200 pounds muriate of potash to the acre.

CCLXII. Early Telephone. First quality.

CCLX. Rosy Morn. First quality.

CCLXIII. Queen of the Valley. Second quality.

CCLIX. White Star. Second quality.

Methods of Analysis.

Specific gravity was determined by weighing the potatoes and also the water which they displaced when put into a jar previously filled with water.

Water. The potatoes after weighing were cut into thin slices, partly dried, ground and again weighed. A portion was further pulverized so as to pass through fine bolting cloth and on this material all subsequent determinations were made. Water was determined by drying at 120° C. in a stream of dry hydrogen.

Starch was determined by Sachsse's method with separation of cellulose, as described on page 132.

Total Nitrogen, by Kjeldahl's method.

Albuminoid Nitrogen was determined by Stutzer's method (Jour. für Landwirthschaft 1881, p. 476. Report of this Station for 1885, p. 40).

Amide Nitrogen, more properly nitrogen of the amides and amido-acids, asparagine etc.—was determined by Sachsse's method (Versuchs-St. XVI. p. 61.)

ANALYSES OF POTATOES.

Station No.	Variety.	Specific Gravity.	Water.	Starch.	Ash.	Other matters, by difference.	Nitrogen.			
							Total.	Albumin-oid.	Amide.	In other forms.
CCLXI	Home Comfort, 1st quality	1.099	75.58	19.39	1.09	3.94	.24	.17	.04	.03
(A)	From New Haven market	1.099	76.23	19.06	---	----	.37	--	--	--
CCXLVI	White Flower, with sulphate	1.091	76.77	18.38	.93	3.92	.38	.21	.10	.07
CCLXVII	White Flower, with muriate	1.082	77.39	17.99	.98	3.64	.35	.19	.08	.18
CCLXII	Early Telephone, 1st quality	1.087	78.08	17.17	.96	3.79	.39	.21	.09	.09
CCLX	Rosy Morn, 1st quality	1.082	79.25	16.53	.85	3.37	.32	.18	.07	.07
CCLXIII	Queen of the Valley, 2d quality	1.072	79.86	15.69	.84	3.61	.39	.23	.09	.07
CCLIX	White Star, 2d quality	1.076	80.99	14.50	1.13	4.38	.32	.16	08	.08

The following percentage statement gives a better idea of the relative quantities of the different forms of nitrogenous matter in these potatoes than the table of analyses presents.

VARIETY.	Per cent. of the Total Nitrogen present in		
	Albuminoids.	Amides.	Other forms.
Home Comfort	71.2	17.6	11.2
White Flower (sulphate)	55.5	27.4	17.1
White Flower (muriate)	54.5	23.8	21.7
Early Telephone	53.5	23.3	23.2
Rosy Morn	54.0	21.6	24.4
Queen of the Valley	59.2	23 5	17.3
White Star	51.9	23.3	18.8

CORRESPONDENCE RELATING TO FEEDING STUFFS.

Fern and Bog Hay.

Referring to an analysis of the buckhorn fern, *Osmunda regalis*, published in our last report, Joshua Lyon, Esq., of Greenwich, writes as follows:

"In the report of the Experiment Station just received I read: 'As far as chemical analysis can indicate, the fern is equal to good meadow hay in composition; but it should be remembered that chemical analysis alone does not positively determine the feeding value.' My experience in regard to its feeding value, not from a scientific point of view but from actual results, is as follows. I have two pieces of ground, one upland, the other lowland. The upland hay consisted of timothy, red-top, etc., and was cut in good season about the 10th of July, and got in in good condition. The swamp hay was cut in the middle of August and a portion of it got wet. It consisted of ferns, bog hay, red-top and some willows [which last the cows did not eat however]. The yield of milk from 18 cows on the good hay was about 160 quarts per day while from the bog hay, fern, etc., it was about 180 quarts per day. The other feed, bran 4 pounds, meal 6 pounds per day was the same in both cases."

Undecorticated Cotton Seed Meal as a Cattle Food.

A sample of this article sent to the Station with the inquiry whether it was sufficiently decorticated to be a safe food, was submitted to Mr. J. J. Webb of Hamden and after receiving his opinion the following answer was sent:—

"The cotton seed meal received from you was submitted to Mr. Webb who has had considerable experience in feeding cotton seed meal to milk cows. He says in regard to it, 'I can see no reason on account of its not being thoroughly decorticated why it should not be a safe food. I fed undecorticated meal for some three winters and discovered no ill effects from it on my cows. Since then I have fed thoroughly decorticated meal and abortions taking place, I was led to suspect that the cotton seed meal was the cause.' It is a fact that many English stock-feeders prefer the undecorticated to the decorticated meal, and claim it is far less likely to cloy the cattle. This may be due to the fact that undecorticated meal is a less concentrated feed than the other or there may be something in the hulls which either medicinally or mechanically helps the digestion."

FIELD EXPERIMENT WITH PHOSPHATES.

Last spring it was proposed to make field experiments to test the relative value of certain phosphates for the corn crop. The land owned by the Station is unsuitable for this purpose because phosphates do not sensibly increase its productiveness, as has been demonstrated by four years' experience. Some years ago Mr. Charles Fairchild of Middletown and Mr. W. I. Bartholomew of Putnam, both proved by a series of field experiments, proposed by Prof. Atwater of Wesleyan University and carried out by them with great skill and care, that their land was strikingly benefited by phosphates, and on this account each of these gentlemen was asked to undertake for the Station the care of an experiment. Mr. Fairchild assented at once and the details of the plan were being arranged when they were interrupted by his sudden death—which was a serious loss to the farming interest of this State.

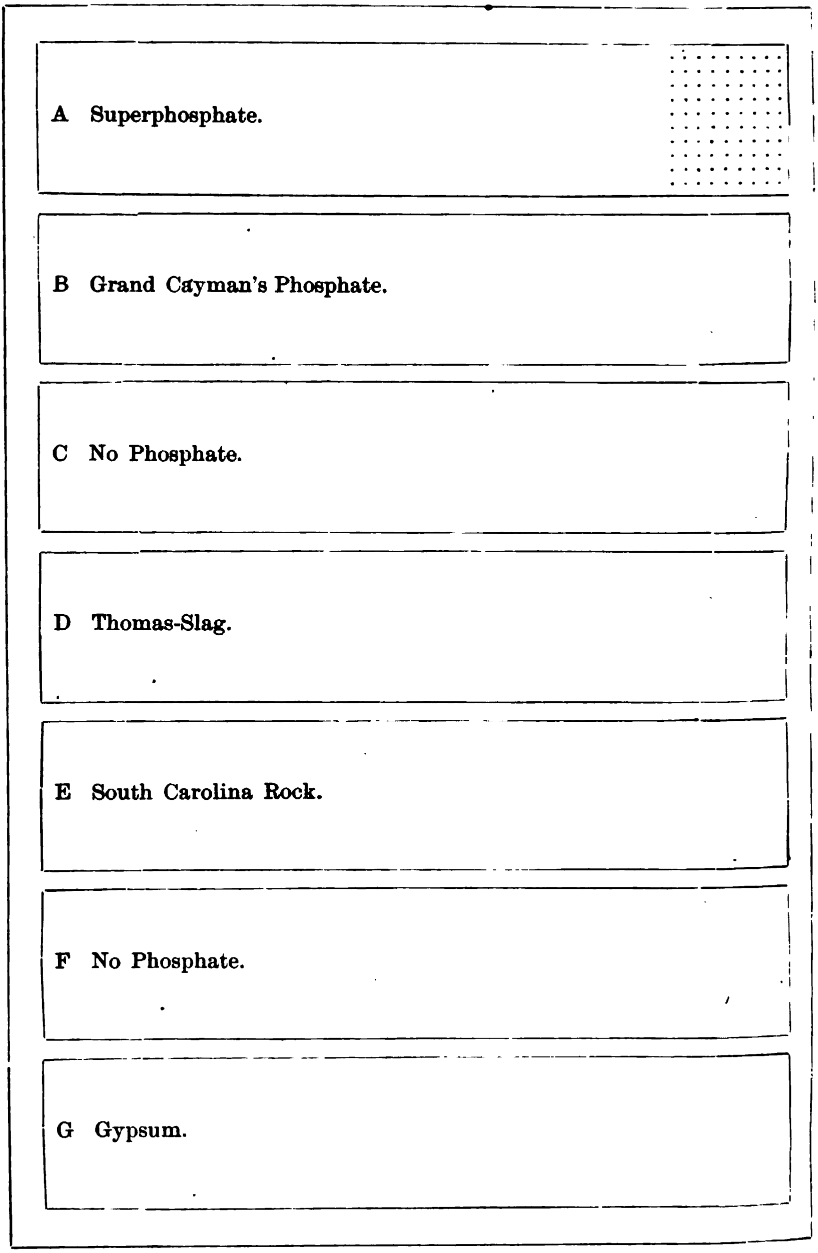
Our first letter to Mr. Bartholomew was lost in the mail which occasioned delay, but having finally secured his coöperation the Station was able to get the fertilizers delivered in time for planting on the 24th of May.

The land used for the experiment was high, gently sloping to the southwest. The soil was a dark loam, moist, with clayey sub-soil. The fall before, it had been sown to rye which was badly winter-killed. Though land in the same field had not been helped in past years by potash salts or nitrogenous manures, it was thought best to use them on the experimental plots to make sure that both available nitrogen and potash should be present in excess of the needs of the crop and that available phosphoric acid should be relatively deficient; in other words so that the total yield would be limited by the quantity of available phosphoric acid in the soil and not by the nitrogen or potash. Accordingly after plowing there were broadcast 200 pounds of muriate of potash and 100 pounds of sulphate of ammonia per acre. The land was then well pulverized with a Thomas smoothing harrow and laid out for the experiment. It was divided into seven plots each 10 rods long and 2 rods wide, or one-eighth of an acre in area. They are distinguished as A, B, C, etc. A plan of the field and more particular description is given on the following page.

The phosphates chosen for comparison were: 1. Dissolved Bone Black, containing 15.83 per cent. of phosphoric acid; 2. A finely pulverized phosphatic rock, from Grand Cayman Island in the Caribbean Sea, containing considerable iron and alumina with 29.49 per cent. of phosphoric acid, placed at our disposal by N. B. Powter, Esq., 181 Pearl street, N. Y.; 3. Thomas-Slag, a byeproduct of the steel manufacture, furnished by Paul Weidinger, Esq., No. 76 Pine street, N. Y., and containing 19.5 per cent. of phosphoric acid. (See page 31); 4. Ground South Carolina Rock, containing about 25 per cent. of phosphoric acid. These phosphates it is well known differ widely in the solubility and presumably also in the availability of their phosphoric acid. It is a practical question however whether their prices stand in direct relation to their agricultural value; whether for some crops it may not pay to use, instead of a small quantity of superphosphate a larger quantity of some other and less soluble phosphate at a lower price. The different phosphates were applied therefore in such quantity as to make the *cost price* in each case approximately the same.

It was necessary first to fix on an application of superphosphate which should insure a fair yield and yet should not be in excess of the requirements of a full crop but rather slightly deficient.

The reason is obvious. Suppose that the land is relatively deficient in phosphates and therefore able to yield but 25 bushels per acre. Suppose also that addition of $3.00 worth of soluble phosphoric acid (superphosphate) would remedy the deficiency



The plots are 2 rods wide and 10 rods long and contain one-eighth of an acre each. The hills of corn are one-fifth of a rod apart each way and the outside hills are one-tenth of a rod from the edge of the plot. Between the plots are spaces one-fifth of a rod wide and in the middle of each space is a single row of potatoes. The whole ground under experiment is surrounded by a double row of potatoes.

and make the crop 50 bushels. Now if $2.50 worth of soluble phosphoric acid is added, this will nearly but not fully meet the requirements of the crop, giving a yield of perhaps 45 bushels and if various phosphates be compared together, those nearly or fully able to feed the crop, will show an increased yield, up to 50 bushels.

If on the other hand $3.50 worth of superphosphate were used, the yield would still be 50 bushels, while other phosphates, though able to feed a larger crop, and more economical, could not show a better effect. Neglect to sufficiently regard this point often leads to quite false conclusions from the results of field experiments.

Experiments made by Mr. Bartholomew in past years[*] with 51, 25½ and 17 pounds of phosphoric acid per acre on land in the same field, had yielded 2900 pounds, 2650 pounds, and 2330 pounds of sound field-cured ears respectively. It was fair to suppose then that 40 pounds of phosphoric acid especially in connection with a full supply of potash and nitrogen would not be in excess of the needs of the crop. Therefore this quantity was taken as the standard and a quantity of superphosphate was used on one-eighth of an acre plot which would furnish one-eighth of 40 or 5 pounds of phosphoric acid. The plots were arranged as follows:

				Costing	Containing Phosphoric acid.	Ton price.
Plot	A	had 32 lbs.	Dissolved Bone Black,	42 cts.	5.1 lbs.	$26.00
“	B	“ 56 “	Grand Cayman's Phosphate,	“	16.5 “	15.00[†]
“	C	“	No phosphate.			
“	D	“ 67½ “	Thomas-Slag,	“	13.2 “	12.50[†]
“	E	“ 70 “	Ground So. Carolina Rock,	“	17.5 “	12.00
“	F	“	No phosphate.			
“	G	“ 16.9 “	Gypsum.			

Contiguous to these plots there was another, H, which received the same quantities of nitrogen and potash as A, but twice as much superphosphate. Another plot was measured off at harvest in Mr. Bartholomew's large field, containing one-eighth of an acre and 500 hills. This land was inverted sod and had received 15 loads of stable manure to the acre and bone dust in the hill besides. It was selected because it appeared to be the heaviest corn in the field. This was called plot X.

It was designed that Plots C and F with no phosphates should show the natural capacity of the land to supply phosphoric acid to the crop. To Plot G was applied a quantity of plaster containing as much sulphuric acid as existed in the superphosphate on Plot A. All the fertilizers were carefully weighed out and bagged at the Station and shipped by freight to Mr. Bartholomew. The phosphates were applied in the hill and the corn was planted on May 24th. The week following, after a gentle rain, dried blood was broadcast at the rate of 100 pounds per acre. It had been delayed on the road and did not come in time to be spread with the other fertilizers. The corn was planted in hills about 3 feet and 3 inches apart each way, making 10 rows or 500 hills in each plot. The seed was Rhode Island White Cap, a flint corn with small ears eight rowed and plump. Two ears on a stalk are rare. It came up well and was thinned at hoeing time to five stalks to a hill. One month after planting the stand on Plot A was decidedly taller and heavier than on the other plots which appeared nearly uniform in these respects. On the 10th of August the following notes were made by Dr. Jenkins who then examined the field.

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[*] Report of Connecticut Board of Agriculture, 1877, pages 357 and 358.

[†] f. o. b. New York.

"Plot A looks nearly as well as other parts of the field which have had 15 loads of stable manure to the acre and bone dust in the hill. It is decidedly the best of the plots in appearance. The corn is more mature, all the anthers have fallen and some tassels are already crisp. The tassels are well developed, having 8–15 side branches.

B and D look about alike. Not as large stalks as A. Anthers still hanging, and tassels not as large as on A.

C is very poor. The corn is not as tall as on those just named, the silk is green, pollen not all fallen, and tassels very imperfectly developed, consisting of a single upright stalk and only one, two or three side branches.

E looks rather better than C and F but not as well as the rest.

G looks perhaps a little better than C and F. There have lately been very severe rains which washed and somewhat gullied the field which slopes gently from A to G, and G *may* have been benefited by this wash, though I doubt it. The whole piece is very accurately laid out, the hills are regular, each of five stalks, very few defective hills."

The year was rather more than commonly good for raising corn, through August and early September particularly, and plots B and D improved very much in appearance. The corn was cut and stacked on the 20th of September and on the 13th and 14th of October it was husked by Mr. Bartholomew's workmen and weighed by Dr. Jenkins.

A weighed portion of the corn on the cob was taken to the Station in order to determine the relation of kernel to cob as well as the dry weight of each. The weights of the field-cured crop are as follows :

Weights in pounds of the Field-Cured Crops.

Plot	Sound Corn on the Cob.	Soft, Immature Corn on the Cob.	Corn Stalks, Leaves & Husks.	Total Weight.
A, Superphosphate	479	108	472	1059
B, Grand Cayman's	469	102	559	1130
C, No Phosphate	319½	178	465½	963
D, Thomas-Slag	463½	90½	494	1048
E, So. Carolina Rock	394	105½	459½	959
F, No Phosphate	343½	140	459½	943
G, Plaster	376	113	456	945
H, Superphosphate, double quantity	----	----	----	1045½
X,	462	65	545	1072

In examining the results it will be noticed :

1st. A fair yield was got on the plots A, B, D, H and X, which had received applications of phosphates. The highest yield, on Plot A, is 479 pounds of sound corn on the cob, or 3832 pounds per acre. Allowing one-sixth for cob,* we have 3194 lbs. of shelled corn, or 57 bushels per acre of field-cured corn, if we reckon 56 pounds to the bushel. Field-cured corn, however, will weigh more than 56 pounds per bushel. From the number of baskets of ears at harvest Mr. Bartholomew reckoned the yield at from 45 to 50 bushels of shelled corn per acre.

2d. It also appears that the land was suited to the experiment because in each case the crop was notably increased by the use of phosphate.

3d. Before comparing the effects of the different phosphates it is necessary to inquire whether on Plot A phosphoric acid was applied in excess of the requirements of the crop,—whether there was more phosphoric acid in the soil than the crop could use. If so, then a close comparison cannot be made between the superphosphate and the other phosphates.

It is seen that the total yield on plot H, with a double quantity of superphosphate, is 1045½ pounds, rather less than on plots

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* The quantity found by actual trial.

A, B and D. The weight of sound corn on X also is rather less than on plots A, B and D, and the total weight of crop is less than on B. It seems clear then, that the yield on A was about all that could be got out of the land this year, and with this variety of seed, and that the quantity of superphosphate was either sufficient for the crop production or was in excess of it.

It should be said that the corn at harvest time *looked* a little heavier and ranker on plot X than on A, and that A *looked* better than B or D, but this appearance was not borne out by the weighing. The considerations already referred to in regard to the effects of phosphates in past years, the slightly higher yield of sound ears on A, together with the general appearance of the crop, leads us to conclude that phosphoric acid on A was not in any considerable excess, but was used in just about the maximum quantity for profit.

4th. Proceeding to a discussion of the results, it appears that the total crop on the plots which had no phosphate was nearly alike and averaged 953 pounds. There was a wider difference in the yield of sound corn (24 pounds.) This was in part due to the difficulty on these plots, not experienced on the others, of making a fair separation of "sound" ears and soft and immature ears. Most of the corn was inferior, but the average yield was 331½ pounds of sound ears. If we call the yield on the no-phosphate plots 100, the yields on the other plots will be as follows:

	Total Crop.	Sound Ears.
No-phosphate	100	100
A, Superphosphate	111	144
B, Grand Cayman's	119	141
D, Thomas-Slag	110	140
E, So. Carolina	101	118
G, Plaster	99	113
H, Double quantity superphosphate	109	——
X, Stable manure and bone dust	112	139

If we deduct from A the increased yield of ears due to gypsum (13) which is shown by G, the comparative yield of sound ears in A is 131.

The difference in total crop is not striking though there is a decided gain over the no-phosphate plots. Where phosphates were used the largest gain was in the weight of the sound ears.

South Carolina Rock showed itself decidedly inferior to the other phosphates, but the Thomas-Slag and the Grand Cayman's

Phosphate produced very nearly the same effect on the crop as was produced by a quantity of superphosphate equivalent to them in cost. This is a point which is of great importance and deserving of further study. A single series of experiments is by no means decisive. The season was particularly good for corn raising and this fact probably was to the advantage of plots B, D and E, as compared with A, because A grew fastest and matured soonest, and in event of a cold August or an early frost, would probably have yielded much better than the others. The general effect of phosphates is to hasten ripening, and the more available they are, the greater will be this effect. This season, however, was so favorable that both the Thomas-Slag and the Grand Cayman's Phosphate yielded all the phosphoric acid which the crop required.

There is another consideration which is in favor of these undissolved phosphates. In the following table is given: 1st, The total quantity of phosphoric acid applied in each case reckoned on an acre; 2d, The quantity removed by the crops harvested, as determined by analysis, and 3d, The quantity still remaining in the soil.

Plot.	Applied. Lbs.	Removed by crop. Lbs.	Remaining in the soil. Lbs.
A	40.6	23.9	16.7
B	132.2	24.5	107.7
D	105.3	23.0	82.3
E	140.0	21.1	118.9

There is every reason to suppose that a part, at least, of the phosphoric left in the soil is as available as that which was removed by the crop and will come to use another year.

This subject is worth further consideration and experiment.

In conclusion, our thanks are due to Mr. Bartholomew for his accuracy, care and skillful management of the experiment which could not have been more successfully carried out at the Station and under our constant supervision.

CONTRIBUTIONS TO THE CHEMICAL STATISTICS OF THE INDIAN CORN CROP.

In case of most cultivated field and garden plants, data are at hand from which can be calculated with fair accuracy the quantities of vegetable substance of the various kinds which are produced upon an acre, as well as the amounts of ash-ingredients and nitrogen withdrawn from the soil by the crop.

The numerous analyses which supply these data have mostly been made in Germany and Austria where maize is not cultivated except in the southern districts of those countries and there more as forage than for the seed grain.

As a consequence very few statistical analyses of the mature maize plant in all its harvested parts are on record and therefore the opportunity furnished by the field trials just described was taken advantage of to enlarge our knowledge in this respect.

Dr. Jenkins carefully sampled the field-cured crop on Plot X, and full analyses of the several kinds of agricultural material thus secured, are here placed on record.

The SOUND CORN AND COB from one-eighth of an acre weighed 462 pounds. A fair sample weighing 10,200 grams (about 22½ pounds) was air-dried in the laboratory and shelled. The shelled corn weighed 6,215 grams and the cob 1,005 grams. The ratio of cob to corn is 1 : 6·18.

The SOFT AND IMMATURE CORN AND COB ("nubbins") from one-eighth of an acre weighed 65 pounds. A fair sample, weighing 4,235 grams (about 9⅓ pounds) was air-dried and shelled. The shelled corn weighed 2,500 grams and the cob 530 grams. The ratio of cob to corn is 1 : 4·72.

The FIELD-CURED STALKS (including leaves and husks) from one-eighth of an acre weighed 545 pounds. The stalks from six stacks or shooks were cut into two-inch pieces in a feed cutter, thoroughly mixed and 9,300 grams (20½ pounds) of the mixture were dried in the laboratory at a gentle heat. After coarse grinding a sub-sample of 685 grams was finely ground and allowed to stand for 24 hours exposed to the air. It then weighed 734 grams and was preserved in a tight bottle for analysis.

The samples thus prepared were analyzed with the results that follow:—

The statements giving the per cents of the several ingredients or classes of ingredients that commonly serve as the basis of computing food-values are termed *proximate analyses.* Besides these, are also given detailed *ash-analyses.*

PROXIMATE ANALYSES OF THE DIFFERENT PARTS OF THE MAIZE CROP, AIR-DRY. PER CENT.

	SOUND CORN. (In the ear.)		SOFT CORN. (In the ear.)		
	Kernel.	Cob.	Kernel.	Cob.	STALKS.
Water	8.71	7.28	9.43	7.50	8.40
Ash*	1.23	1.39	1.32	2.00	6.26
Albuminoids†	11.06	2.00	10.44	2.81	6.93
Fiber	1.07	33.24	1.32	31.93	29.75
Nitrogen-free Extract‡	72.28	55.49	72.50	55.20	47.08
Fat (Ether Extract)	5.65	.60	4.99	.56	1.58
	100.00	100.00	100.00	100.00	100.00

It is noticeable, in contrasting the sound with the soft corn, that while the per cent. of albuminoids in the kernels of the former is somewhat greater than in those of the latter, in the cob the relation is reversed. A similar compensation is seen in case of fiber; the soft kernels contain relatively more than the sound, but the soft cobs less. These differences stand connected with the maturing process. The sound, i. e., ripe corn is, pound for pound of dry matter, somewhat more nutritious than the soft. The soft corn in air-drying also retains a little more water than the sound.

COMPOSITION OF THE DIFFERENT PARTS OF THE MAIZE CROP, FIELD CURED. PER CENT.

	SOUND CORN. Kernel and Cob.	SOFT CORN. Kernel and Cob.	STALKS.
Water	35.25	34.99	48.65
Ash	.89	1.03	3.50
Albuminoids	6.93	6.51	3.89
Fiber	3.93	4.77	16.69
Nitrogen-free Extract	49.50	49.69	26.41
Fat (Ether Extract)	3.50	3.01	.88
	100.00	100.00	100.00

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* Free from charcoal, carbonic acid and water.

† More correctly nitrogen reckoned as albuminoids. Amide-nitrogen, etc., are included.

‡ Starch, sugar, gum, and similar carbhydrates reckoned by difference.

This statement is derived from the foregoing analyses by calculation, the ascertained loss of water in passing from the field-dry to the air-dry (or more correctly house-dry) state and the proportions of kernel to cob, being important factors in the reckoning.

The sound corn and soft corn in the ear, field-cured, have very nearly the same per cent. of water. The soft corn has almost half a per cent. less of albuminoids as well as of fat than exists in the sound corn, and eight-tenths of a per cent. more fiber. This inferiority is in part due to the greater proportion of cob to kernel in the soft corn.

COMPOSITION OF THE ASH OF THE DIFFERENT PARTS OF THE MAIZE CROP. PER CENT.

	KERNELS,		COB,		
	of Sound Corn.	of Soft Corn.	of Sound Corn.	of Soft Corn.	STALKS.
Potash (K_2O)	30.84	30.82	61.16	58.49	39.28
Soda (Na_2O)	.68	.72	.75	.97	.81
Lime (CaO)	.61	.78	1.44	2.02	8.02
Magnesia (MgO)	15.11	14.30	2.28	3.31	3.43
Oxide of Iron (Fe_2O_3)	trace	trace	.10	.14	.83
Sulphuric Acid (SO_3)	.78	1.68	2.59	3.70	3.18
Phosphoric Acid (P_2O_5)	48.64	47.71	4.73	6.22	4.75
Chlorine	.14	.28	4.74	6.32	8.38
Silica and Sand (by difference)	3.23	3.77	23.30	20.10	33.21
	100.03	100.06	101.09	101.27	101.89
Deduct Oxygen equivalent to Chlorine,	.03	.06	1.09	1.27	1.89
	100.00	100.00	100.00	100.00	100.00
Per cent. of Ash	1.23	1.32	1.39	2.00	6.26

Of the total quantity of ash in the cob, nearly or quite three-fifths consists of actual potash. In the cob the potash is probably chiefly combined with organic acids and in the ash remains as carbonate. These facts justify the common impression that cob-ashes are particularly valuable for soap-making or for fertilizing purposes.

The ash of the stalks has a higher per cent. of potash than the kernel. The per cent. of phosphoric acid in the stalks is small, about like that of the cob.

Nearly half the ash of the kernel consists of phosphoric acid, which is mostly combined with potash and magnesia, so that we may say the ash of the seeds of maize, as of other cereal grains, is nine-tenths or more phosphates of potash and magnesia.

COMPOSITION OF THE FIELD-CURED MAIZE CROP. POUNDS PER ACRE.

	SOUND CORN.		SOFT CORN.		STALKS.	TOTAL.
	Kernel.	Cob.	Kernel.	Cob.		
Water	1303		182		2119	3604
Ash	27.7	5.1	4.1	1.3	153.1	191.2
Albuminoids*	249.0	7.3	32.1	1.8	169.7	459.9
Fiber	24.1	121.1	4.1	20.8	727.7	897.6
Nitrogen-free Extract	1627.3	202.1	222.4	35.9	1151.9	3239.6
Fat (Ether Extract)	127.2	2.2	15.3	.4	38.7	183.7
Total	3696		520		4360	8576.0

From this statement it appears that more than a third of the most valuable food-ingredient of the crop, namely the albuminoids, was contained in the stalks; about the same relative amount of the nitrogen-free extract and about one-fifth of the fat was also found in the stalks.

The food-value of maize stalks is generally recognized, though they are often used carelessly, being thrown into the barnyard to be picked over by the cattle and then worked into the manure. As far as the chemical composition of their dry matter goes they compare very favorably with timothy or meadow hay, as the following statement shows :

COMPOSITION OF THE DRY MATTER OF FIELD-CURED CORN-STALKS, TIMOTHY HAY AND MEADOW HAY OF AVERAGE QUALITY.

	Corn Stalks.	Timothy.	Meadow Hay.
Ash	6.83	4.58	5.57
Albuminoids	7.57	6.74	7.38
Fiber	32.47	33.82	36.79
Nitrogen-free Extract	51.40	52.50	47.85
Fat	1.73	2.36	2.41
	100.00	100.00	100.00

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* More properly nitrogenous matters reckoned as albuminoids.

ASH-INGREDIENTS AND NITROGEN IN THE MAIZE CROP. (Pounds per acre.)

	Sound Corn.		Soft Corn.			
	Kernel.	Cob.	Kernel.	Cob.	Stalks.	Total.
Potash	8.5	3.2	1.3	.8	60.2	74.0
Soda	.2	trace	trace	trace	1.2	1.4
Lime	.2	.1	trace	trace	12.3	12.6
Magnesia	4.2	.1	.6	trace	5.3	10.2
Oxide of iron	trace	trace	trace	trace	1.3	1.3
Sulphuric Acid	.2	.1	.1	.1	4.9	5.4
Phosphoric Acid	13.5	.2	1.9	.1	7.3	23.0
Chlorine	trace	.2	trace	.1	12.8	13.1
Silica and Sand	.9	1.2	.2	.2	50.9	53.4
	27.7	5.1	4.1	1.3	156.2	194.4
Deduct oxygen equivalent to chlorine	....	....	....	....	3.1	3.2
Total	27.7	5.1	4.1	1.3	153.1	191.2
Nitrogen	39.8	1.2	5.1	.3	27.2	73.6

From this table it appears that more than four-fifths of the potash taken from the land by this corn crop, one-third of the phosphoric acid and more than one-third of the nitrogen were contained in the stalks.

The demand of this crop upon the soil for nitrogen and potash removed in the harvest was the same—74 lbs. per acre. The amount of phosphoric acid carried off was but 23 lbs.

It will be interesting here to compare these figures with the results of a similar investigation made at the New Jersey station in 1883.* In this experiment a variety of Dent corn was planted in hills 3½ feet apart each way on land heavily manured. It yielded 68.3 bushels of shelled corn and 2.2 tons of dried stalks per acre. The total yields per acre were as follows:

	Kernels.		Cobs.		Stalks.		Total.		Entire crop reckoned on 1000 lbs. of dry substance.	
	N. J.	Ct.	N. J.	Ct.	N. J.	Ct.	N. J.	Ct.	N. J.	Ct.
Ash	55.4	31.8	12.6	6.4	193.9	153.1	261.9	191.3	34.5	38.5
Albuminoids	328.9	281.1	18.4	9.1	165.3	169.7	512.6	459.9	67.4	92.5
Fiber	69.2	28.2	269.2	141.9	1313.0	727.7	1651.4	897.8	217.2	180.6
Nitrogen-free Extract	2602.7	1849.7	483.6	238.0	1895.3	1151.9	4981.6	3239.6	655.3	651.5
Fat	149.5	142.5	2.8	2.6	42.8	38.7	195.1	183.8	25.6	36.9
	3824.0	2333.3	950.0	398.0	4041.0	436.0	7602.6	4972.4	1000.0	1000.0
Nitrogen	52.7	43.9	2.9	1.5	26.3	27.2	81.9	72.6	10.8	14.6
Phos. Acid	27.2	15.4	2.6	.3	15.0	7.3	44.8	23.0	5.9	4.6
Potash	15.3	9.8	4.8	4.0	33.1	60.2	53.2	74.0	7.0	14.9

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* Report of the New Jersey Agricultural Experiment Station, 1884, p. 127.

In 1000 lbs. of dry matter the Connecticut crop contained considerably more albuminoids and fat and correspondingly less fiber than the New Jersey crop, the proportion of non-nitrogenous extract (i. e., starch, sugar and the like), being nearly the same in both. It is remarkable that the Connecticut crop contained more than twice the proportion of potash that existed in the New Jersey crop. These striking differences as well as the widely unlike total yield of grain and stalks, stand related, no doubt, largely to difference in the varieties of the corn that were the subjects of trial, and in a less degree to difference of climate and season as well as to quality of soil and quantity of fertilizers.

Indian corn exhibits a very great diversity of development according to external conditions and the large dent varieties may be expected to differ greatly from the smaller flint sorts in their requirements as they do in their dimensions of stalk and ear.

The differences in percentage composition of the kernel, however, will be comparatively slight.

Investigations at the New Jersey Experiment Station have shown:

1st. That a larger quantity of digestible food may be obtained from an acre of field corn than from an acre of fodder corn, *if the stalks are fed without waste.*

2d. That the digestible carbhydrates (digestible fibre and nitrogen-free extract together) of corn meal and corn stalks when fed to cows do not differ in their effect on the quantity of milk produced.

3d. That the substitution of corn ensilage for corn meal and corn stalks does not affect the flow of milk.

4th. It was demonstrated that corn stalks, cut and finely shredded, were eaten as clean and were as valuable feed as hay.

RELATIVE FEEDING-VALUE OF THE LEAVES, HUSKS AND STRIPPED STALKS.

No data were gathered on this point for the flint corn raised by Mr. Bartholomew. Later in the season we obtained from Mr. J. J. Webb, of Hamden, a sample of the stover which he was then feeding. The variety was "White Edge Dent." This stover is stacked near his barns in stacks 15 feet in diameter, and 12 to 15 feet high. These apparently suffer damage from the weather only to a depth of a very few inches. As needed, the stover or fodder corn is taken to the barn. The sample which we took, though not sensibly damp, contained, as the analysis shows, more water by 20 per cent. than field-cured stover usually contains. It had, however, a bright, fresh color and no trace of musty or moldy smell. The leaves and husks were separated completely, and the stripped stalks were cut in two at the sixth joint from the butt, so that the two pieces were about equal in length.

The weights of the several parts in the fresh state, the weights of their dry matter and the percentage of the total dry matter which each part contained, are as follows:

	Fresh (ounces.)	Dry Matter (ounces.)	Per cent.
Leaves	153.0	85.6	32.
Husks	124.1	59.6	22.
Upper half of stalks	57.3	31.1	12.
Lower " "	267.6	91.1	34.
	602.0	267.4	100.

The analyses of these parts, both in their fresh and water-free condition, are given below.

ANALYSES OF DIFFERENT PARTS OF STOVER, FIELD-CURED.

	Leaves.	Husks.	Upper half of stalks.	Lower half of stalks.
Water	44.02	52.00	45.67	65.94
Ash *	5.04	2.07	2.46	1.22
Albuminoids	4.91	2.71	1.88	1.10
Fiber	17.98	16.79	22.57	15.03
Nitrogen-free Extract	27.28	25.82	26.76	16.23
Fat	.77	.61	.66	.48
	100.00	100.00	100.00	100.00

ANALYSES OF DIFFERENT PARTS OF STOVER, WATER-FREE.

	Leaves.	Husks.	Upper half of stalks.	Lower half of stalks.
Ash *	9.00	4.30	4.52	3.60
Albuminoids	8.77	5.66	3.45	3.24
Fiber	32.09	34.98	41.54	44.19
Nitrogen-free Extract	48.76	53.78	49.28	47.55
Fat	1.38	1.28	1.21	1.42
	100.00	100.00	100.00	100.00

The following table calculated from the foregoing shows the quantity of each nutrient in each part of 1000 pounds of *dry* (water-free) stover:

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* Free from char, water and carbonic acid.

	Leaves.	Husks.	Upper part of stalks.	Lower part of stalks.	Total.
Ash	28.8	9.6	5.3	12.3	56.0
Albuminoids	28.1	12.6	4.0	11.0	55.7
Fiber	102.7	78.0	48.4	150.5	379.6
Nitrogen-free Extract	156.1	119.7	57.3	162.1	495.2
Fat	4.4	2.8	1.4	4.9	13.5
	320.1	222.7	116.4	340.8	1000.0

In this experiment with stover from Dent corn it appeared:

1st. About one-third of the dry matter of the stover was in the leaves, one-third in the lower half of the stalks and one-third in the husks and upper half of the stalks.

2d. The leaves, as was to have been expected, were far richer in mineral matter and albuminoids than any other part and had less fiber. The husks in chemical composition stood next in value to the leaves. The upper part of the stripped stalks did not differ greatly in composition from the lower part.

3d. One-fifth of the albuminoids, one-third of the nitrogen-free extract (starch, gum, etc.), and ether extract (fat), and between one-third and one-half of the fiber of the stover were in the lower half of the stalks.

There is no reason to believe that there is any great difference in the digestibility of the different parts of stover, but to make the stalks acceptable to cattle they must be cut, crushed or shredded. On some farms it will pay to do this, on others perhaps not. The observations above cited may be serviceable in helping to a decision in particular cases. Mr. Webb cuts his fodder and field-corn in inch pieces with an ensilage cutter, and his cattle eat it, leaving only very little.

ON THE

DETERMINATION OF NITROGEN IN FERTILIZERS CONTAINING NITRATES BY JODLBAUER'S MODIFICATION OF THE KJELDAHL METHOD.

By E. H. Farrington, M.S.

The Kjeldahl method has proved itself a very convenient and accurate method of determining nitrogen in fertilizers and agricultural products which are free from nitrates.

Jodlbauer (Chem. Centralb. **17**, 433 and Fres. Zeitschr. **26**, 1887, 92) has proposed a modification of the method which renders it applicable to substances containing nitrates as well as to pure nitrates. This modification is essentially as follows:

.2–.5 grm. of a pure nitrate, or a corresponding quantity of a substance containing nitrates is introduced into a flask with 20 cc. concentrated sulphuric acid and 2.5 cc. of phenol-sulphonic acid,—prepared by dissolving 50 grams of crystallized phenol in enough concentrated sulphuric acid to make the volume 100 cc.—and 2–3 grams of zinc dust and 5 drops of platinum chloride solution which contains .04 grams platinum in 1 cc. are also added. After 4 hours boiling in the usual way the liquid is colorless and ready for further treatment according to Kjeldahl's method. By adding to 200 grams phosphoric anhydride enough oil of vitriol to make the volume 1000 cc. and using 20 cc. of this acid instead of pure sulphuric acid, the time required for boiling is reduced one-half but the glass flasks are rapidly attacked.

Stutzer and Reitmair (Rep. Anal. Chem., **7**, 4–6) find that Jodlbauer's method fails to yield accurate results if the acid acts on compact masses of the substance. They obtain good results by proceeding as follows: One gram of substance is introduced into the flask with 25 cc. of water which is evaporated in an air bath and leaves the nitrates more uniformly distributed. 50 cc. of sulphuric acid containing 20 grams of phenol per liter are added and allowed to stand a few minutes. 2–3 grams of zinc dust are then added and one or two drops of mercury and the process is conducted from this point as usual.

In experiments with these methods at this Station it appeared that the digestion in the cold after adding the phenol-sulphonic acid, suggested by Stutzer and Reitmair, was very important.

Better results too were obtained, in the case of fertilizers, with the ordinary commercial 66° acid than with the so-called "chemically pure" acid or with an acid made still stronger by addition of fuming sulphuric acid. An objection to the use of "chemically pure" acid of the trade lies in the fact that it usually contains so much sulphate of ammonia as to make the required correction too large to be satisfactory.

Station No.	Condition of the Nitrogen.			Total Nitrogen found.		Differences.	
	As Nitrates.	As Ammonia.	Organic Nitrogen.	By Dumas' method.	By modified Kjeldahl-Jodlbauer's method.	Minus.	Plus.
1812	3.38	----	----	3.38	3.40	--	.02
1872	3.24	----	----	3.24	3.27	--	.03
1873	3.06	----	----	3.06	3.04	.02	--
1874	.82	1.06	.58	2.56	2.49	.07	--
1918	.74	----	2.45	3.21	3.16	.05	--
1930	1.61	1.55	.69	3.92	3.78	.14	--
1936	.52	.69	2.91	4.23	4.06	.17	--
1949	.67	.18	2.92	3.79	3.74	.05	--
1964	.42	----	2.68	3.06	3.12	--	.06
1968	.30	.65	2.97	3.97	4.06	--	.09
1969	.51	----	2.73	3.16	3.27	--	.11
1975	.30	----	2.55	2.85	2.89	--	.04
2008	1.37	2.59	1.41	5.43	5.32	.11	--
2009	.78	.60	1.16	2.58	2.50	.08	--
2011	.79	.91	1.92	3.58	3.65	--	.07
2013	.66	.55	1.11	2.32	2.15	.17	--
2014	.63	.05	1.73	2.48	2.34	.14	--
2027	.51	2.36	2.79	5.68	5.65	.03	--
2030	.62	1.06	2.31	3.98	4.00	--	02
2034	.45	.37	2.83	3.69	3.66	.03	--
2035	.61	1.85	1.66	4.08	4.16	--	.08
2036	1.14	1.29	1.51	3.95	3.93	.02	--
2041	.58	.09	2.49	3.16	3.01	.15	-
2050	.79	.51	3.26	4.47	4.26	.21	-
2051	4.15	----	.38	4.56	4.49	.07	--
2055	.54	2.69	1.42	4.48	4.65	--	.17
2056	.66	2.41	2.43	5.44	5.46	--	.02
2057	.83	1.87	1.94	4.61	4.66	--	.05
2068	3.81	----	1.90	5.76	5.65	.11	--
2070	.66	2.38	1.07	4.11	3.98	--	.13
2071	.39	----	2.32	2.72	2.69	--	.03
2074	.41	.57	1.85	2.83	2.82	.01	--
2089	3.93	----	1.38	5.34	5.28	.06	--
2090	2.85	----	1.03	3.89	3.87	.02	--

Thus 50 cc. of "chemically pure" acid contained .017 grams nitrogen.
50 cc. of fuming sulphuric " " .004 " "
50 cc. of commercial, impure, 66° acid contained .0029 grams nitrogen.

I have found the following precautions and slight modifications to give very satisfactory results in fertilizer analysis.

1 gram of the fertilizer is digested in a flask with 50 cc. of a solution of 50 grams of crystallized phenol in one liter of commercial oil of vitriol of 66° B. This mixture is allowed to stand in the cold for half an hour with frequent shaking. To it are then added 2–3 grams of zinc dust, and .7 gram mercuric oxide. The contents of the flask are then heated gradually and boiled till colorless and subsequently treated according to Kjeldahl's directions.

In the preceding table are given all the results obtained by this method in comparison with results obtained by combustion of the same substances with copper oxide in the way described in the Reports of this Station for 1878 and 1879. The combustions with copper oxide were made by Mr. Winton, the determinations by the Kjeldahl–Jodlbauer method by myself.

An inspection of these results shows that in 68 per cent. of the cases, the difference between the two methods was not over 0.1 per cent. and in 88 per cent. of the cases not over .15 per cent. The greatest difference, No. 2050, was .21 per cent.

The plus differences are 14 in number, the minus differences 20. The average of the former is .066, of the latter .085. It is evident then that the two methods are about equally accurate.

25,2

75.[illegible]

NOTES ON THE DETERMINATION OF STARCH.

By A. L. Winton, Jr., Ph.B.

The determination of pure anhydrous starch in different varieties of commercial starch may be satisfactorily accomplished by heating the substance with dilute hydrochloric acid according to Sachsse's method, determining the dextrose thus formed by Allihn's method, and from the dextrose found, reckoning the starch.

It is claimed that direct heating of the substance with acid is not admissible in the case of potatoes, grains and other agricultural products, partly because cellulose also is in a measure converted into dextrose by acids and partly because the acid dissolves certain ash ingredients which would be afterwards precipitated by alkaline copper solution.

Several methods for separating the starch from such substances have been devised and it was with the view of learning how they compared with each other as regards accuracy and convenience that the following investigations were undertaken.

ALLIHN'S METHOD FOR DETERMINATION OF DEXTROSE.*

Since in all the methods for estimation of starch which I have tested with the exception of Asboth's the starch is converted into dextrose, it is of first importance that the method used for determining dextrose should be trustworthy and properly executed.

Allihn's directions are briefly as follows:

For preparing alkaline copper solutions, two solutions are made up.

Solution No. I. contains 173 grms. Rochelle salts and 125 grms. Caustic potash dissolved in water and made up to 500 cc.

No. II. contains 34.69 grms. crystallized copper sulphate dissolved in water and also made up to 500 cc.

60 cc. of alkaline copper solution prepared immediately before using by mixing 30 cc. No. I. and 30 cc. No. II. are heated just to boiling in a beaker of 300 cc. capacity over a lamp. To the boiling liquid 25 cc. of dextrose solution (containing not more than .25 grms. dextrose) are added and the heating further continued until boiling begins again. After the reduced copper suboxide has settled it is collected on a weighed asbestus filter, washed with cold water (at first by decantation) finally with alcohol and ether and dried at 100° C. The copper suboxide is reduced to metallic copper by heating to redness in a stream of dry hydrogen, and to prevent oxidation is cooled in the same gas. From Allihn's table the weight of dextrose, corresponding to the weight of copper, is found.

For an asbestus filter a Gooch crucible with a thick layer of asbestus may be used, although in my experience the filtering tubes described by Allihn are more convenient and retain the finely divided precipitate better. These are easily made from a piece of hard glass tubing 4 inches long and $\frac{3}{8}$ of an inch in diameter by drawing out one end to a small opening and slightly expanding the other. In the narrow portion of the tube a small platinum cone is fitted and a layer of asbestus $\frac{1}{2}$ inch deep is packed in with the aid of a suction pump and a glass rod.

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* Jour. für Prak. Chem., **22**, 52. Fres. Zeit. für Anal. Chem., **22**, 448.

For reducing the copper suboxide the tube is attached by means of a perforated cork to the apparatus which provides a stream of dry hydrogen and after air has been expelled it is carefully ignited in a free flame and cooled before turning off the hydrogen.

In using the method, the following precautions are essential:

I. The solutions for preparing alkaline copper solution must be freshly made and never mixed until immediately before using.

II. After adding the dextrose solution the liquid is simply heated to boiling and *not longer.* 4 minutes boiling brings the result one per cent. or more high.

III. As soon as the precipitate has settled it is collected without further delay on the weighed filter.

IV. Care must be taken that the filter completely retains the precipitate. It is a good practice to let the washings stand for sometime so that if any of the copper suboxide has run through it may subside. In suspension it is hardly visible.

The above method gave me perfectly accurate results with pure, anhydrous dextrose and was used in all the determinations of dextrose which were made in the following investigation.

ACTION OF DILUTE SULPHURIC ACID ON DEXTROSE.

Since the methods of determining starch involve a treatment with dilute sulphuric or hydrochloric acid it is important to know whether the dextrose formed in the process is itself subsequently changed by the acid.

The experiments of both Allihn and Salomon seem to show that sulphuric acid is poorly adapted for the conversion of starch into dextrose.

The former in an elaborate series of experiments using .1, .2, .5, and 1 per cent. sulphuric acid, and heating under pressure at temperatures from 100° C. to 114° C. was not able under the most favorable circumstances to obtain more than 95 per cent. of the starch in the form of sugar.

Salomon finds the chief difficulty to be in the change into "humus-like" substances which dextrose undergoes on protracted heating with sulphuric acid. Owing to the formation of such substances the solution gradually darkens in color.

50 cc. of a solution of dextrose which contained 4.678 grms. of the pure dry substance after boiling 4 hours with 20 cc. of 5 per cent. sulphuric acid was found by him to contain but 4.446 grms.

of dextrose, in other words but 95 per cent. of the original quantity. 5 per cent. sulphuric acid is, however, twice the strength of the acid ordinarily used for this purpose.

Prof. R. H. Chittenden (of Yale Univ.) has found that dextrose is not altered on boiling two hours with 2 per cent. sulphuric acid, still a modification of his method described further on in which the starch was first treated with saliva until the solution gave no reaction with iodine solution, then boiled two hours with 2 per cent. sulphuric acid, gave results which were 1 per cent. low.

Action of Dilute Hydrochloric Acid on Dextrose.

Four portions of pure anhydrous dextrose of about 2.5 grms. each were digested with 2 per cent. hydrochloric acid exactly as prescribed by Sachsse's method to be described further on (page 132) except that the time of heating was varied. After cooling, the acid was nearly neutralized with sodium hydrate, and dextrose determined by Allihn's method.

The following are the results :

	Time of Heating.	Per cent. of Dextrose.	Color of Solution.
I.	1 hour	100.24	Colorless.
II.	3 hours	100.22	Light straw.
III.	11 hours	96.85	Dark yellow.
IV.	17 hours	94.59	Dark brown.

The solutions which after one hour's heating still remained colorless and after three hours were but slightly tinged with yellow, on further heating soon began to darken in color.

No. I. and II. show that after three hours heating the dextrose remained practically unchanged, whilst on the other hand III. heated 11 hours was found to have lost 3.15 per cent., IV. heated 17 hours 5.46 per cent. of the original quantity of dextrose. From these experiments we conclude that the action of 2 per cent. hydrochloric acid on the dextrose as employed in Sachsse's method is not sufficient to appreciably affect the results. Heating longer than three hours brings the results low.

In order to have for experiment starch of known composition a quantity was prepared from potatoes and after being allowed to dry in the air was carefully bottled and used in all the following experiments. In this sample, water, ash, fiber and starch were determined by the methods used by Allihn* and Salomon† as follows:—

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* Jour. f. Prak. Chem. 22–79.

† Jour. f. Prak. Chem. 28–84.

Water: Two grams were dried to a constant weight at 120° C. in a stream of hydrogen.

Ash: The burning to ash was carried on in a muffle furnace at a heat below redness.

Fiber: The flocks which remained undissolved after converting the starch into sugar were filtered on a weighed filter, dried at 100° C. and weighed.

Starch: By Sachsse's method to be described immediately.

RESULTS OF ANALYSES OF POTATO STARCH.

	I.	II.	III.	Average.
Water	15.16	15.18	....	15.17
Ash	.63	.61	....	.62
Fiber	.01	.03	...	.02
Starch	84.55	84.37	84.69	84.54
				100.35

The most approved methods of determining Starch were next tested as follows:—

SACHSSE'S METHOD FOR DETERMINATION OF STARCH.

[Chem. Centralbl. 1877, p. 732.]

3 grms. of the air-dry substance are heated in a boiling water bath for 3 hours with 200 cc. water and 20 cc. of a 25 per cent. hydrochloric acid (Sp. gr. 1.125).

The flask is provided with a condenser consisting simply of a long tube ½ inch in diameter attached by means of a perforated rubber stopper. After cooling, enough sodium hydrate solution of known strength is added to nearly (but not quite) neutralize the acid and the liquid is made up to 250 cc. (or some other convenient volume) and an aliquot portion of 25 cc. used for estimating dextrose by Allihn's method already described.

The weight of dextrose multiplied by .9 gives the weight of starch, considering its formula to be $C_6 H_{10} O_5$. In the sample referred to, this method gave 84.54 per cent. of starch.

PROF. CHITTENDEN'S METHOD OF DETERMINING STARCH WITH USE OF SALIVA.

The details of this method which have been furnished us by Prof. Chittenden are as follows:—

3 grms. of the finely powdered substance are made into a paste of even thickness, with 400 cc. of boiling water. After cooling to

40° C. 15 cc. of filtered and neutralized saliva are added and the temperature kept at 40°* until a drop of the liquid gives no coloration with iodine solution.

For neutralizing the saliva .2 per cent. hydrochloric acid is added drop by drop until the reaction with delicate litmus paper is neutral (the diastatic action of normally alkaline saliva is increased by neutralizing it). An excess of acid must be avoided since .003 per cent. hydrochloric acid almost completely checks the action of the ferment.†

The soluble dextrine and maltose into which the starch has been completely changed, are separated from the insoluble matter by filtering.

The filtrate after concentration to 200 cc. is treated with hydrochloric acid precisely as in Sachsse's method and dextrose is determined by Allihn's method.

The following results on the potato starch of my preparation were obtained by this method.

	I.	II.	Average.
	84.45	84.85	84.65
By Sachsse's method	....	....	84.54

The advantage which saliva as a ferment in starch analysis has over the malt extract usually employed, is that it does not, like the latter, contain soluble carbhydrates which become converted during the process into dextrose.

When, however, a large number of determinations are to be made and it is impossible for the chemist to supply a sufficient quantity of saliva, malt extract must be used. In this case a blank analysis with the malt extract is made by the same process as the others and a correction made.

Malt extract is best prepared by treating 50 grms. of malt with 1000 cc. of water for 3 hours at 40° C. About 25 cc. of this extract are equivalent to 15 cc. of neutralized saliva.

The digestion of the substance in which starch is to be determined with this ferment solution is carried on at 50°–55° C.

To further illustrate the importance of limiting the heating with dilute hydrochloric acid to three hours, three portions of starch were treated by Chittenden's method exactly as described above except that the heating with acid was continued 17 hours.

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* Studies from the Laboratory of Physiolog. Chem. Sheffield Scientific School, for the year 1884–1885, 121.

† Chittenden, l. c., p. 1.

The results were 3 per cent. low.

	I.	II.	III.	Average.
	81.15	81.88	80.93	81.32
By Sachsse's method	----	----	----	84.54

In the following trials a 2 per cent. sulphuric acid was substituted for a 2 per cent. hydrochloric acid. The solutions of starch in saliva were boiled gently over a Bunsen burner for 2 hours.

Although the color of the solution was quite dark the results are but 1 per cent. low.

	I.	II.	III.	Average.
	83.48	83.61	83.56	83.55
By Sachsse's method	----	----	----	84.54

MÄRCKER'S EARLIER METHOD FOR DETERMINATION OF STARCH IN POTATOES.

[Land. Versuchs. St. 25–107.]

This method was used by Märcker in the analysis of a large number of samples of potatoes. From the results thus obtained he has prepared his tables for the rough estimation of the starch content of potatoes from the specific gravity of the tuber. This method has been extensively employed for the determination of starch in grains and feeding stuf[illegible].

3 grms. of the finely pulverized air-dry potatoes are heated with 50 cc. of water for 4 hours at 135°–140° C. under pressure (3–4 atmospheres). After cooling to 90° the starch which has been converted into the soluble modification is separated from the insoluble matter by filtering with the aid of suction.

The filtrate is made up to 200 cc. and treated with hydrochloric acid as in Sachsse's method. After neutralizing the acid with sodium hydrate, 7–8 cc. of basic lead acetate are added to precipitate pectin substances, and the liquid is made up to 500 cc. and filtered through a dry filter. 200 cc. of the filtrate are made up to 250 cc. with 1 per cent. sulphuric acid and after the precipitated lead sulphate has settled, once more filtered through a dry filter and dextrose determined in 25 cc. of the filtrate.

For converting the starch into the soluble modification we have heated the substance, contained in a brass vessel, covered with a tightly fitting lid together with 50 cc. of water in a Müncke's steam digester.

In using this apparatus care must be taken not to allow the pressure to fall off after digestion so rapidly as to occasion mechanical loss from the violent boiling of the contents of the vessels.

Solution of basic lead acetate is prepared by boiling 155 grms. of lead acetate and 109 grms. litharge with 400 cc. of water and making the filtrate up to 500 cc.

Results obtained on the nearly pure potato starch agree with those by preceding methods.

	I.	II.	Average.
By Märcker's method	84.50	84.77	84.63
By Chittenden's method			84.65
By Sachsse's method	....	....	84.54

MÄRCKER'S LATER METHOD FOR DETERMINATION OF STARCH IN GRAINS AND POTATOES.

[Chem. Zeit. ix, 319.]

[Reprinted Fres. Zeitschr. 24, 617.]

3 grms. of the finely ground substance are heated with 50 cc. of water to 90° C. and after cooling to 65° mixed with 5 cc. cold malt-extract (50 grms. of malt extracted with 1000 cc. water). After digesting ½ hour (at 65° or better at 55°), 10 cc. of 1 per cent. tartaric acid solution are added and the mixture heated under a pressure of 3 to 4 atmospheres for ½ hour as has been described. When cooled to 65°, 5 cc. malt extract are again added and after ½ hour the insoluble portion is removed by filtration. The filtrate is heated on a boiling water bath 2½ hours with 15 cc. of 25 per cent. hydrochloric acid, and enough water to make a volume of 200 cc.

The acid is then nearly neutralized with sodium hydrate and dextrose is determined by Allihn's method. Märcker states that by this method a complete solution of the starch is effected without any appreciable decomposition of the dextrose.

In order to verify this statement and also to study the solvent action of tartaric acid under pressure, 4 portions of potato starch of 2.5 grms. each were weighed out into brass vessels.

I. and II. were treated exactly as has been described with ferment solution and tartaric acid except for reasons before stated 5 cc. of neutralized saliva were substituted for 5 cc. of malt extract.

III. was digested directly with 55 cc. of water and 10 cc. 1 per cent. tartaric acid. The treatment was the same as for I. and II. except that addition of ferment solution was omitted.

IV. was simply heated under pressure for ½ hour with 65 cc. of water.

All four were heated (without filtering) with hydrochloric acid as directed, neutralized with sodium hydrate, made up to 250 cc. and dextrose determined in 25 cc. From the dextrose the percentage of starch was computed.

I.	84.86
II.	84.47
III.	84.67
IV.	84.81

These results indicate that the conversion into dextrose was in each case complete.

After digestion with saliva in I. and II. the starch was only partially in solution, although the diastatic action of 5 cc. of saliva is greater than of 5 cc. of malt extract. The quantity of anhydrous starch in 2.5 grms. of potato starch is about the same as in 3 grms. of air-dry potatoes.

The object of this first digestion with ferment solution recommended by Märcker is apparently not to effect complete solution of the starch but to remove the larger part of it so that tartaric acid may act more readily on that which may be enveloped in vegetable tissue.

In III. heated under pressure ½ hour with tartaric acid the solution of the starch was complete, whilst IV. heated in the same way with water alone was still milky from undissolved starch.

The addition of .1 grm. of tartaric acid shortens the time of heating necessary for effecting a complete solution of the starch.

The results obtained on pure potato starch by both of Märcker's methods and by Chittenden's method agree with those by direct conversion with acid according to Sachsse's method, and with the result got by difference where water, ash and cellulose were determined.

In each case the starch was brought into solution before the digestion with acid so that if insoluble matter had been present it could have been separated and in each case also the total amount of starch used was obtained finally in the form of dextrose.

Comparison of these Methods on Potatoes.

It seemed next desirable for the sake of comparative results to estimate the starch in a sample of potatoes by each of these methods. For this purpose a number of sound potatoes were cleaned, weighed, cut into thin slices and dried in a current of warm air. They were then ground rather coarsely, taking care to avoid loss, and after standing exposed to the air several days were again weighed and a subsample was taken and reduced to a fine meal, all of which passed through a bolting cloth.

This air-dry substance amounted to 24.5 per cent. of the fresh sample.

Duplicate portions of three grams of this air-dry potato-meal were treated as follows:

1. By Märcker's earlier method.
2. Same as 1, except that "pectin substances," etc., were not removed by precipitation with basic lead acetate.
3. By Märcker's later method.
4. By Chittenden's method.
5. By Sachsse's method without separating cellulose, which was filtered out in 1, 2, 3 and 4.

The solutions of dextrose were in each case made up to 250 c. c., and 25 c.c. was used for the determination.

	Per cent. of Starch found in Air-dry Sample.		
	I.	II.	Average.
1........	67.05	66.52	66.78
2........	68.60	67.98	68.29
3........	69.78, 69.30	69.46	69.51
4........	69.30	68.76	69.03
5........	71.60	71.64	71.62

It is evident from 1 and 2 that basic lead acetate removes substances which reduce alkaline copper solution; in 2, 3, 4 and 5, however, this was purposely omitted, as probably the error in each case would be the same and would not alter the value of the results for comparison.

The results in 5, where the material was digested directly with hydrochloric acid without previous separation of cellulose, etc., are considerably higher than any of the others. These higher results were at first supposed to be due to the partial conversion of cellulose into dextrose by heating with hydrochloric acid. In order to ascertain whether this supposition was correct, the residues which had been separated in 2, 3 and 4, of which those from 2 and 4 had been dried at 100° and weighed, were soaked in water until soft, then ground to a pulp, and finally digested with two per cent. hydrochloric acid for three hours, neutralized, made up to 250 c.c. and the copper reduced by 25 c.c. was determined.

	Reduced Copper.		Per cent. of starch equivalent to copper.		Per cent. of dry residue.	
	I.	II.	I.	II.	I.	II.
2	.0010	.0017	----	----	5.66	5.70
3	.0019	.0022	----	----	Not weighed.	
4	.0099	.0131	1.96	2.56	9.33	10.37

To our surprise the reduced copper in 2 and 3, if added to that obtained from the soluble portion, was not sufficient to make .4 per cent. difference in the results, even if the fact is disregarded, that the boiling of alkaline copper solution alone invariably reduces a little copper.

In 4, on the other hand, the reduced copper was equivalent to 1.96 per cent. of starch in I. and to 2.56 per cent. in II. The weights of the dried residues in this case were also much greater than in 2. In 4, the total reducing power of the soluble portion and residue, after treating with acid, nearly agree with that where the sample was digested directly with acid. Thus:

	Reducing Power reckoned as Starch.		
	4. (Chittenden's saliva method.)		5. (Direct conversion.)
	I.	II.	
Soluble in saliva	69.30	68.76	----
Insoluble in saliva	1.96	2.56	----
Total	71.26	71.32	71.60

What the residues in 4 contained after digestion with hydrochloric acid which reduced alkaline copper solution is not known. Possibly the starch was not completely in solution or the washings may have been incomplete, as the residue was slimy and was washed with difficulty, but it cannot be concluded that cellulose was converted to such an extent into dextrose, since little or no reduced copper was obtained when the residues in 2 and 3 were treated in the same way.

Why the results by either of Märcker's methods are lower than those by direct conversion cannot be explained except by considering that an actual decomposition takes place on digestion under pressure.

Our experiments seem to show that pure starch treated by either of Märcker's methods can be completely recovered as dextrose, but in the case of the potato other substances are present which may themselves decompose or may cause a decomposition of starch. The potato also contains water-soluble matters which reduce alkaline copper solution. From the potato-meal here operated on I extracted by cold water matters, reducing copper which reckoned as dextrose amounted to 3.59 per cent. Having proved that in this particular sample of potatoes, the troublesome operations which Märcker employs for removing cellulose previous to digestion with acid are needless, the question arose whether the same would hold true for other samples of potatoes and for the cereal grains and other agricultural products in which it is often desirable to accurately determine starch as a measure of their value for the manufacturer of commercial starch or of alcohol, and also whether it would hold true for pepper in which starch is often determined to decide whether the sample is pure or adulterated.

The following experiments were made to cover these points. Samples of graham flour, maize meal (prepared from the whole kernel), rice (without the hulls), beans and pepper were finely pulverized, and, with the exception of the graham flour, were sifted through bolting cloth.

In portions of 3 grams each, starch was dissolved and separated from the cellulose and other insoluble substances by Märcker's earlier method (digestion with water for 4 hours under pressure of 3–4 atmospheres) and by his later method (digestion with malt-extract ½ hour, then with tartaric acid under a pressure of 3–4 atmospheres ½ hour and finally again with malt-extract). The starch solution was filtered off immediately from the residue, which was washed quickly and thoroughly with boiling water, for when starch is simply brought into solution by digestion under pressure with water alone, it is necessary to filter without delay while hot, as starch is precipitated on cooling.

The residues were digested 3 hours with 200 c.c. of water and 20 c.c. of hydrochloric acid (sp. gr. 1.125) and reducing substances in the resulting solutions after filtration were determined in 25 c.c., corresponding to .3 grams of substance, by Allihn's method and calculated as starch when possible. When the weight of reduced copper is less than 10 milligrams, the reducing substance expressed in terms of starch can not be determined by the use of Allihn's tables.

The results appear in the following statement :—

	Residues from Märcker's earlier method yielded—		Residues from Märcker's later method yielded—	
	Copper.	Equivalent to per cent. of Starch.	Copper.	Equivalent to per cent. of Starch.
Graham flour	.0015	----	.0000	----
Maize	.0010	----	.0017	---
Rice	.0002	----	.0008	----
Potatoes, 1st sample	.0010	----	.0022	---
Potatoes, 2d sample	.0017 .0010 .0000	---- ---- ----	.0019 0022	----
Beans	.0060	.92	.0073	1.11
Pepper	.0087	1.33	.0130	1.98

These results indicate that in determining starch, no appreciable error is introduced by omitting the separation of cellulose and other insoluble matters before digestion with hydrochloric acid in the case of graham flour, maize meal, rice and potatoes. In the case of beans and pepper there is a considerable quantity of some copper-reducing material produced by the action of acid on the insoluble matters. Whether this is due to hydration of cellulose does not appear. But in those materials in which *accurate* starch determinations are most desirable the insoluble matters yielded only a minute quantity of reducing substance when heated with acid.

As further evidence, a third sample of potatoes from an entirely different source was put through the process for separating cellulose according to Märcker's earlier method, and the residue digested with acid as before. In this case 12 grams of the air-dry substance was used, so that the 25 c. c. of the solution corresponded to 1.2 grams, or four times what had been used in preceding cases. The weight of reduced copper was but .0016 grams.

We therefore conclude that the simplest and in other respects the most satisfactory method for estimating starch in potatoes and cereal grains, is to digest the air-dry sample directly with a two per cent. hydrochloric acid and proceed in other respects as has been described.

Notes on Asboth's Method of Determining Starch.

[Repert. Anal. Chemie. No. 20. Translation in Analyst, xii, 138.]

Asboth has shown that baryta starch $[C_6H_{10}O_5]_4BaO$, first prepared by Zulkowsky by the action of baryta water on soluble starch, is also formed and precipitated when baryta water is added to starch which is simply suspended in water in the form of paste.

On this reaction he bases a volumetric method for the determination of starch in cereals which is here copied from the Analyst, vol. xii, page 140.

ESTIMATION OF STARCH.

"Weigh out about three grams of the flour and rub well in a mortar with cold water; but in the case of hard substances like maize, rice, peas, boiling water must be used. Pour off into a 250 c. c. flask, and rub residue again and again with small quantities of water, until the bulk of the starch is removed; finally introduce residue also into the flask. Add water up to about 100 c. c., and heat in water-bath for half an hour, with occasional stirring. After cooling, add 50 c. c. of standard baryta water; cork the flask, and shake well for two minutes. To completely separate the baryta starch, add proof spirit up to the mark. After ten minutes pipette off 50 c. c., but if a flocculent precipitate refuses to settle, filter a portion of the fluid through glass-wool contained in a tube." "Titrate the excess of BaO with decinormal hydrochloric acid, using phenolphthalein as an indicator. The interval during the settling of the precipitate I utilized in standardizing the baryta water."

"I use 10 c. c. baryta water, and add 50 c. c. of thoroughly boiled distilled water before checking it." "The difference in BaO between the two determinations was first multiplied by 5, then by 4.235 = amount of starch."

"An analysis can be finished in about an hour and a half. I must call attention to the fact that if the liquid is not frequently shaken during the heating, there will be a tendency to form lumps of starch paste which are but imperfectly acted on by baryta water."

I have tried this method on the pure potato starch previously described with the following results:

	Asboth's Method.	Sachsse's Method.
Pure Starch	82.83, 83.02, 83.79	84.54

With pure starch the titration was quite sharp, the color changing with a single drop of acid, but with potatoes, however, the point of neutrality can only be approximately determined, so that although duplicate results made by the same chemist at the same time may agree, it is extremely difficult to decide whether the point of absolute neutrality has been reached or not.

A little difference of opinion on this point would alter the results one or two per cent. Even with pure starch, where the titration was comparatively easy, it is much more difficult to get sharp results than by gravimetric methods. We have also made determinations of starch by Asboth's method in the [air-dry] potatoes sent by Mr. Platt as follows:

	Asboth's Method.			Sachsse's Method.
CCXLVI	70.14	70.87		73.81
CCXLVII	74.00	73.60		73.60
CCLIX	72.08	71.69		69.96
CCLX	70.00	70.22		72.40
CCLXI	69.88	70.66		72.07
CCLXII	62.11	63.19	63.62	70.60
CCLXIII	62.97	62.29		70.68

ANALYSES OF PARIS GREEN, AND REMARKS ON THE USE OF INSECTICIDES.

Paris Green is now used in large quantities to destroy the potato beetle, and also to protect fruit trees from the codling moth and certain other insect pests. It is a compound of arsenious acid (white arsenic), acetic acid and copper, and owes its poisonous properties to the arsenic in it.

Formerly four or five brands of this article were in the market, "Strictly Pure" being what the name implied, the others consisting of varying proportions of Paris Green and some makeweight.

We have been unable this year to find any other brand than "Strictly Pure" in our market, and are told that no other brand is now manufactured. The following analyses were made by Dr. Osborne, to determine whether the "Strictly Pure" Paris Green in market is what its name indicates:

A. Made by C. T. Raynolds & Co., New York. Bought of W. A. Spalding, New Haven.

B. Made by Raynolds & Co. Bought of R. Wells & Co., New Haven.

C. Bought of Cowles & Leete, New Haven.

D. From a package with Schieffelin's label. Bought of J. H. Klock & Co., New Haven.

E. Bought of F. S. Platt, New Haven.

F. Bought of Davenport & Burt, Putnam.

ANALYSES.

	A	B	C	D	E	F
Water	1.09	1.01	1.05	.96	1.22	.94
Copper oxide	30.90	30.94	30.77	30.87	30.54	31.05
Arsenious oxide	57.22	57.10	57.23	57.04	56.97	57.18
Acetic acid by difference	10.79	10.95	10.95	11.13	11.27	10.83
	100.00	100.00	100.00	100.00	100.00	100.00

The samples cost uniformly 35 cents a pound, except D, for which 40 cents was asked.

Paris Green is manufactured in this country by several companies who have formed an association to control the production and price. Their prices for next season they have not yet made public but they have already guaranteed that prices will be lower than last year. At present Paris Green can be bought at retail for 35 cents per pound, and in large lots at 28 to 30 cents, but not under that. Dealers cannot buy it of the manufacturers in 500 lb. lots for less than 18 cents.

At present London Purple is a much cheaper insecticide than Paris Green. It should contain nearly as much arsenic, and costs less than half as much. Still another insecticide which could be obtained much more cheaply than either of those named is "White Arsenic," which consists wholly of arsenious acid, and therefore has from 1.7 to 2 times as much poison in it pound for pound as either Paris Green or London Purple. A common price for it at the apothecaries, is 25 cents a pound. But it sells at wholesale for 3 cents, and reliable druggists say that it would sell for 6 or 8 cents retail if there was any demand for it. A very serious objection to the use of "White Arsenic," however, is its pure white color, which makes it resemble saleratus, soda, salt, and other things used in cooking. Neither London Purple or Paris Green could be so mistaken. If "White Arsenic" is bought, it should *never* be taken from the shop until mixed with lampblack or pulverized charcoal. One-fifth of an ounce of either is sufficient to blacken a pound of arsenic.

Prof. A. J. Cook, of the Michigan Agricultural College, in a letter on the subject, says:

"The danger, through carelessness, from the use of Paris Green or London Purple is almost as nothing compared with that of White Arsenic. I have thoroughly experimented with both the latter, and find not a trace of them in the foliage of potatoes, nor in the tubers, when every advantage was given for such absorption. I have done the same with apples. No trace of the poison is found on or in the fruit. White arsenic is easily mixed, is very effective, and as far as I have tried it, does no more harm to vegetation. But I do not think it cheaper than London Purple, and no better. I have found this year that one-half pound of London Purple to 100 gallons of water is enough.

The mixture above referred to is designed for spraying fruit trees.

One pound of Paris Green mixed with 100 pounds of plaster is sufficiently strong to use on potatoes. It has been repeatedly noticed that a large quantity of the poison is less efficacious than a small one, perhaps because the beetle avoids a mass of it, while the barest trace is as deadly as any larger quantity. Many prefer to use the poison in water, because there is less danger of inhaling it. In that case a heaping spoonful in a pail of water is enough.

THE METHODS OF MECHANICAL SOIL-ANALYSIS.

By Thomas B. Osborne, Ph.D.

In the report for 1886 were given the first results of an investigation of the methods of mechanical soil-analysis. The method of Knop as modified by Moore and that of Hilgard, as well as one developed in the Station laboratory were there discussed and compared. Since then the investigation has been extended to Schöne's method, and to the process of Schlösing which combines chemical and mechanical treatment.

These methods comprise all hitherto proposed that now appear to be worthy of investigation, the others such as Schulze's, Nöbel's, Müller's, Kühn's, Masure's and others, either employ conical elutriating vessels, which as Hilgard has pointed out and this investigation fully confirms, give wholly incorrect results, or they are methods depending on subsidence through a given height of water for a definite length of time, a principle which experience has shown is not adapted to yield results of value with any certainty whatever.

SCHÖNE'S METHOD.

The apparatus used, obtained from Müncke, of Berlin, was similar to that described and figured by Schöne (Zeitschrift f. Analytische Chemie, 7, 1868, p. 29), with the addition, suggested by Orth, of a second elutriating tube having a diameter one-half that of the Schöne tube.* Water was supplied to the apparatus under a constant pressure by means of a Mariotte's bottle.

Schöne's elutriator has been so frequently described that any further reference to its construction is unnecessary. The hydraulic values of the different currents used were not directly determined but the flow of water was so regulated as to carry off only such particles as had diameters equal to or less than the upper limit of the grade to be separated. It was thus easy to obtain results strictly comparable with those given by the other methods used.

In the first trial made, the soils were subjected to no preparatory treatment beyond simple sifting. The samples were neither boiled with water nor acted on by hydrochloric acid nor by alkali-solutions.

Schöne, in his original paper, following Schübler and Schulze, prescribes boiling as a needful preliminary in all cases. Clayey soils containing much humus he says should be boiled an hour with water containing in solution 1–2 per cent. of alkali hydroxide. Sandy soils he directs to free from organic matters by ignition and calcareous earth he recommends to treat with cold dilute hydrochloric acid to remove carbonate of lime.

As serious objections may be urged against all these last mentioned modes of preparation, it was determined to make some trials on the simply sifted earth, in order to gain an idea of the extent to which the soil could be differentiated without their aid, the results of applying the method of Beaker elutriation being employed as standards of comparison.

Twenty grams of the air-dry soil were sifted under water through a quarter-millimeter sieve. The fine material which after passing the sieve remained suspended in the water was poured into the Schöne tube, the coarser portion being rinsed into the Orth tube. The water current was then regulated so that the largest particles of quartz carried off had an average diameter of $.01^{mm}$.

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* Die Agronomische Bodenuntersuchungen und Kartirung, von Dr. Max Fesca, Berlin, 1879, pp. 19, and 143, also Albert Orth, Ueber Mechanische und Chemische Bodenanalyse. Bericht d. D. Ch. Gesellschaft, xv, p. 3026.

When the current ceased to remove any appreciable quantity of the soil its velocity was increased so that the largest quartz grains passing over had a diameter of .05^{mm}. These portions were collected in separate vessels.

As Hilgard noticed in the case of Schulze's elutriator, secondary currents formed during the process of elutriation which descended along the walls of the conical part of the Schöne tube and for some distance along the sides of its cylindrical portion. The result of these currents was to produce globular aggregates of small particles which fell to the bottom of the tube. These flocculæ could be to some extent broken up by turning on from time to time for a few seconds a rapid current of water, but a very considerable proportion of them remained unbroken to the end of the elutriation and were only moved forward when the current was increased so as to carry off the coarsest grade.

SOIL FROM GARDEN OF THE EXPERIMENT STATION.—NOT BOILED.

ANALYSES WITH THE SCHÖNE–ORTH ELUTRIATOR.

	A.	B.
Above .25^{mm}	48.82	48.82
.25–.05^{mm}	27.36	29.94
.05–.01^{mm}	8.63	6.07
.01– 0^{mm}	7.36	7.31
Clay (by difference)*	1.00	1.03
Loss on ignition	6.83	6.83
	100.00	100.00

The coarser products obtained in these analyses, under the microscope were seen to contain material finer than properly belonged to them. The various sediments of A were therefore subjected to systematic beaker elutriation and the finer material thus readily separated was in each case weighed and its quantity added or subtracted as required to make the obvious corrections. The following figures show the outcome of this correction compared with the original analysis and with the results of direct beaker elutriations.

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* "Clay," as given in this and in the other analyses by the Schöne and Beaker methods instanced in this paper, is, in accordance with Hilgard's conventional method, that part of the grade having diameters of from .01–0^{mm} which remains suspended after 24 hours' sedimentation from water having a depth of 200^{mm}.

Neither Schöne nor the various experimenters who have employed his method in analysis of soils appear to have undertaken to subdivide the grade .01–0^{mm}.

SOIL FROM GARDEN OF THE EXPERIMENT STATION.—NOT BOILED.

	A. Schöne-Orth Elutriation.	A-1. A. Corrected by Beaker Method.	Average of 3 Direct Beaker Elutriations.*
Above .25mm	48.82	48.82	48.82
.25–.05mm	27.36	23.72	22.37
.05–.01mm	8.63	12.08	13.70
.01– 0mm	7.36	7.55	7.20
Clay (by difference)	1.00	1.00	1.08
Loss on ignition	6.83	6.83	6.83
	100.00	100.00	100.00

The agreement between the results by direct beaker elutriation and the corrected Schöne-Orth elutriation is perhaps quite as close as could be expected. The uncorrected S.-O. elutriation materially differs from the direct beaker analysis in the 2d and 3d grades only and by five per cent. in each case.

The sample of Prairie soil whose analyses by other methods were reported last year was next examined. Fifteen grams were carefully worked with a rubber pestle to disintegrate as far as practicable all the lumps and separate the loosely adhering particles. The sample was then elutriated in the manner just described. The following figures show the results thus obtained as well as those yielded by the beaker method, as given in the Report of this Station for 1886, p. 157.

PRAIRIE SOIL FROM MERCER COUNTY, ILL.—NOT BOILED.

	C. Schöne-Orth Elutriation.	No. 33. Beaker Method.
Above .25mm	.76	.62
.25–.05mm	11.25	2.42
.05–.01mm	52.65	43.58
.01– 0mm	14.84	31.58
Clay	4.44	5.81
Loss on ignition	14.49	14.49
	98.43	98.50

Here the differences between the results of the two methods are such as to show positively that the Schöne process is worthless, when applied to an unboiled soil of this character. This prairie earth is difficult to elutriate with a current of water because of its large content of very finely divided organic matter.

A sample of brick clay elutriated as in the above analyses gave the following results:

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* Report of Conn. Ag. Exp. Station for 1886, p. 148.

BRICK CLAY FROM NORTH HAVEN, CONN.*

	D. Schöne-Orth Elutriation.	No. 50. Beaker Method.
Above .25mm	1.02	1.02
.25-.05mm	3.91	.76
.05-.01mm	29.63	20.95
.01- 0mm	58.58	71.01
Loss on ignition	6.60	6.60
	99.74	100.34

We note that in this ancient drift deposit which has never been cultivated and contains no visible organic debris the Schöne elutriation totally fails to make even a rough separation of the several grades of fine matter from the unboiled soil. This failure is doubtless partly due to the fact that the current of water cannot fully disintegrate the clay, but it is also due in part to the coalescence of once separated particles as they encounter each other in the elutriating process. The coarser products of elutriation contained large numbers of fine particles which under the microscope were seen adhering to one another in groups of from four or five up to twenty or thirty. During the analysis these flocculæ could be seen at all times in the process of formation in the elutriator, and when once formed, as Hilgard has shown, they adhere together with great persistence.

THE BERLIN-SCHÖNE METHOD.

In his original paper as printed 20 years ago in *Fresenius' Zeitschrift*, Schöne gave no definite instructions with regard to the proper duration of boiling as preliminary to the elutriating process, nor have any further communications from him on the subject appeared in the current literature. In the mean time his apparatus as modified by Orth has been adopted and extensively employed in the *Laboratorium für Bodenkunde*, of the Royal Prussian Geological *Landesanstalt* at Berlin. The elutriations by the Schöne apparatus that remain to be described in this paper were made as nearly as possible in accordance with the instructions that have emanated from the Berlin *Bodenlaboratorium* and are as follows:†

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* Not the sample analyses of which were given in Report of this Station for 1886.

† Untersuchungen des Bodens der Umgegend von Berlin, von Dr. Ernst Laufer und Dr. Felix Wahnschaffe, Berlin, 1881, pp. 14-24; also Dr. Max Fesca, Agr. Bodenuntersuchungen, p. 143. Dr. Wahnschaffe's lately published work, "Bodenuntersuchungen" had not been received when this paper went to the printer.

500 grams of the soil are sifted upon circular holes 2^{mm} diameter. Of the earth passing the sieve 30 to 100 grams are boiled in water with constant stirring for from one-half to one hour or longer, according to the character of the soil. The finer the texture of the soil the smaller the quantity taken and the longer the time of boiling. Treatment with acids or alkalies is not practiced.

The finer portion of the soil remaining suspended in the water after boiling is poured into the Schöne tube, the remaining coarse part is rinsed into the Orth tube. The clay, together with the finest sand, is collected in a separate vessel, the water in which it is suspended is evaporated off and the residue after drying in the air is weighed. The rest of the operation is carried out as previously described except that the products of elutriation are not ignited but weighed air-dry, in order that they may be further examined chemically if desired. By proceeding in this manner the following results were obtained:

SOIL FROM THE GARDEN OF THE EXPERIMENT STATION, boiled 45 minutes.

Separations by the Berlin-Schöne Method.

	Air dried.	Ignited.
Above .05^{mm}	72.63	71.76
.05–.01^{mm}	14.17	12.53
.01–0	12.97	9.38
Loss on ignition	----	6.83
	99.77	99.50

For the sake of comparing the mechanical separations attainable by this procedure with those yielded by other methods, the air-dry products were ignited and again weighed and our further statements have reference chiefly to the latter.

By subtracting from the ignited portion above .05^{mm}, 49.37 per cent. the amount of this soil that remained upon a .25^{mm} sieve, the fraction between .25^{mm} and .05^{mm} is found and the separations in this analysis may be compared with those previously obtained by the Beaker Method as follows:—

SOIL FROM GARDEN OF EXPERIMENT STATION.

		Beaker Method.		
	E. Berlin-Schöne Boiled 45 min.	Boiled 23 hours av. of 4 analyses.	No. 29. Pestled, not boiled.	Not boiled nor pestled, av. of 3 analyses.
Above .25^{mm}	49.37	47.77	48.82	48.82
.25–.05^{mm}	21.39	20.75	22.44	22.37
.05–.01^{mm}	12.53	11.18	12.55	13.70
.01–0 clay included	9.38	13.47	9.36	8.28
Loss on ignition	6.83	6.83	6.83	6.83
	99.50	100.00	100.00	100.00

Separations thus accomplished by the Berlin-Schöne method, show a very remarkable quantitative agreement with those made by the beaker method but the coincidence is more apparent than real, for on subjecting the two coarser products to beaker elutriation they were each found to contain a not inconsiderable amount of material belonging to the finer grades. The boiling for only a short time had, apparently, given the sample a composition quite different from that obtained on elutriating the unboiled soil but had not reduced it to the condition of those samples which were boiled for 23 hours. See analyses A and B, p. 146.

The following figures show the weights and per cents. of material removed by beaker elutriations from the 2d and 3d products of the foregoing analysis:

	Wt. of fractions in grams.	Wt. of substance removed.	Per cent. removed.
	Air Dried.		
.25^{mm} to .05^{mm}	22.31	2.84	12.76
.05^{mm}–.01^{mm}	14.17	1.19	8.37
	Ignited.		
.25^{mm}–.05^{mm}	21.39	2.37	11.07
.05^{mm}–.01^{mm}	12.53	.81	6.48

The above figures supply the data for calculating a corrected Berlin-Schöne analysis which is here compared with the uncorrected analysis and with results of a beaker elutriation made directly on a sample of the same soil boiled for the same time, viz: three quarters of an hour.

SOIL FROM GARDEN OF EXPERIMENT STATION, boiled 45 minutes.

	E. Berlin-Schöne Method.	E. 1. E. Corrected by the Beaker Method.	No. 49. Beaker Method.
Above .25^{mm}	49.37	49.37	49.52
.25–.05^{mm}	21.39	19.02	19.50
.05–.01^{mm}	12.53	14.09	13.11
.01–.0	9.38	10.19	11.04
Loss on ignition	6.83	6.83	6.83
	99.50	99.50	100.00

In case of heavy loams the inability of the Berlin–Schöne method to effect even a roughly approximate separation of the several grades becomes very conspicuous, as is evident from the following figures:

CLAY LOAM, DEER RIVER, LEWIS CO., N. Y.

	Boiled One Hour.		Not Boiled.	
	Berlin-Schöne. F.	Beaker. No. 51.	Beaker. No. 30.	Beaker. No. 31.
Above .25	22.39	20.26	20.92	19.91
.25–.05	26.72	18.96	17.96	18.41
.05–.01	21.75	23.70	25.26	26·94
.01–.0	21.45	23.32	23.05	22.00
Clay		5.10*	3.55*	4.75†
Loss by Ignition	7.99	7.99	7.99	7.99
	100.30	99.33	98.73	100.00

The beaker analyses, Nos. 30 and 31, were made on this soil a year ago (report of this Station, 1886, p. 155), and are adduced for comparison with the recent analysis, No. 51. The soil here under consideration presents peculiar difficulties from the fact that it contains long-weathered fragments of clay-slate and of limestone and sandstone shales which break up on agitation, as in boiling or by pestling, into sand-grains of various grades, and into clay, so that any means which may be employed to disintegrate the existing clay, and detach it from the coarser matters, must pulverize the latter to some extent, and thus alter the mechanical composition of the soil. In my former paper, the effects of long boiling alone, and of boiling and churn-elutriation together, in reducing the coarser and increasing the finer sediments, are set forth. Here it will be seen on comparing the beaker analyses, that boiling for one hour seems to have had little effect on the two coarser grades of this loam, but has apparently diminished the 3d grade by about 2.4 per cent., and increased the 4th and 5th by nearly the same amount. But the beaker method, for the reason above stated, cannot be expected to give such closely corresponding results on this soil as to demonstrate by a single comparison the effect of boiling for one hour.

Comparing now the two analyses made on samples of the soil similarly prepared by boiling for one hour, we notice that the first two grades in the Schöne elutriation are 9.9 per cent. higher than by the beaker process, and the three finer grades are correspondingly lower.

The last elutriation, G, attempted by this method, was on a sample of the same brick clay, whose analysis, made with the unboiled earth, has been given already. For convenience of comparison the former analysis, D, is here copied, and the results of a correction of G, by the beaker method, are also stated.

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* Determined directly.

† Clay and loss by difference.

BRICK CLAY, FROM NORTH HAVEN, CONN.

	Berlin-Schöne Elutriation.			
	D. Not Boiled.	G. Boiled One Hour.	G 1. G, Corrected by Beaker Elutriation.	No. 50. Direct Beaker Elutriation.
Above .25	1.02	1.02	1.02	1.02
.25–.05	3.91	4.58	.68	.76
.05–.01	29.63	29.94	22.90	20.95
.01–.0 Clay	58.58	57.14	68.08	71.01
Loss by Ignition	6.60	6.60	6.60	6.60
	99.74	99.28	99.28	100.34

The two analyses, D and G, agree very closely, the boiling of this clay for one hour in case of G, has had but little effect over the *preliminary* pestling applied to D, in increasing the per cent. of the finest at the expense of the coarser grades.

The composition of the several sediments from the Schöne–Orth apparatus in analysis G, as found by subjecting them separately to beaker elutriation is stated in the subjoined table. The up-and-down columns under G give the Schöne–Orth elutriation products and their sub-divisions effected by the beaker process. The cross-page figures under G, when added together, give the corrected analysis G 1.

NORTH HAVEN BRICK CLAY. BOILED ONE HOUR.

	G. Berlin-Schöne Method.					G 1. G, Corrected by Beaker Elutriation.
	Above .05	.05–.01.	.01–.0.	Loss on Ignition.	Total.	
Siftings	1.02					1.02
.25–.05	.68					.68
.05–.01	2.07	20.83				22.90
.01–.0	.89	6.13	57.14			64.16
Clay	.94	2.98				3.92
Loss by Ignition				6.60		6.60
Totals G	5.60	29.94	57.14	6.60	99.28	G. 1. 99.28

SCHLŒSING'S METHOD.

According to Grandeau (Traité d'analyse des Matières Agricoles, 1887, p. 137), Schlœsing's method, "has the great advantage over all the other mechanical methods yet proposed, of making known the exact content of clay and sand in the soil. The very fine sand which closely resembles clay in its physical properties, and yet in chemical character is so entirely different is not here, as in all the mechanical analyses, confounded with the clay." By this method humus and carbonates are also determined.

In the analyses thus far given in this paper, the term " clay " has been applied to that portion of the soil which remained in suspension after allowing the water in which it had been diffused, the height of which was 200^{mm}, to stand at rest for 24 hours (Hilgard's Conventional Method). By this means a product is obtained which consists of the greater part of the *true clay* contained in the soil, together with a considerable amount of very fine sand. The importance of separating this very fine sand from the true clay is obvious, for the chemical properties of the two are very unlike, and their influence on the physical character of the soil is different.

By *true clay* is here meant that material, mostly derived from the decomposition of feldspars and similar silicates, which is capable of uniting with a very considerable amount of water, and thus assuming a gelatinous condition in which it exerts a powerful binding action upon the particles of sand in the soil. To some extent, probably, this action is also exerted by iron and alumina hydroxides, as well as by colloid organic bodies. A relatively small amount of such clay is able to modify greatly the physical properties of a large amount of fine sand with which it is admixed, and to influence the agricultural character of the soil to a very marked degree.

Therefore, in view of the claims made for Schlœsing's method, the clay obtained by his process was carefully examined for sand.

Grandeau claims for Schlœsing's method more than Schlœsing himself. The latter in his *Contribution a l'Etude de la Chemie Agricole*, *Encyclopedie Chimique*, t. x., 1885, p. 86, remarks, " We have reckoned as clay all those elements which remain in suspension in water after a repose of 24 hours. In reality these elements contain a notable proportion of very fine sand which will be deposited in the course of time. In order that the liquid may be entirely rid of this sand it is necessary to wait several weeks or even months. Such a prolongation of the analysis is evidently inadmissible. I have proposed a rest of 24 hours, for the deposition of clay.

This is a conventional time, but this convention is justified by the fact that the sediment which we call clay presents, when it has a suitable degree of humidity, a cohesion and a plasticity in all respects analogous to that of the natural clays."

The method as described by Grandeau is briefly as follows:

1. Thorough mechanical subdivision of the sample by working under water with the fingers.
2. Further disintegration of the sample by solution of the lime salts in weak hydrochloric acid.
3. The solution of humus in dilute caustic potash or ammonia.
4. The separation of the humus and clay from the sand by means of repeated (up to 5 or 6) subsidences of 24 hours duration.
5. Separation of the clay and humus by precipitation of the clay by potassium chloride.
6. Determination of the amount of humus by precipitating its ammonia solution by acetic acid and lead acetate.
7. Separating the sand into several grades by sifting or levigation.

The directions in Grandeau's *Traité d'analyse des matières Agricóles*, p. 138, were carefully followed * and the results of the analyses are believed to show correctly how far the claims made by Grandeau for this method admit of vindication.

A calcareous brick clay and a prairie soil, rich in organic matter, were selected as suitable material for testing the method.

BRICK CLAY. NORTH HAVEN, CONN.
H.

Schlœsing's Method.

Carbonate of lime	4.20
Sand	64.91
Clay	22.65
Humus	None
Loss on ignition	6.60
	98.36

Before weighing "sand" in the above analysis obtained by following Grandeau's directions it was further examined as follows: In order to remove any still adhering clay it was pestled, suspended in water and allowed to settle for 24 hours when the water and suspended soil were poured off. The sediment thus obtained was repeatedly treated in the same manner until it subsided leaving the water perfectly clear. The clay and fine sand thus removed were suspended in water and allowed to stand for several days. The supernatant liquid was poured off and the sediment thoroughly pestled and treated in the same manner as the "sand" had been. This process was repeated until the clay-water deposited no particles of sand having a diameter greater than ·002^{mm}, and all the sand which had been deposited from the clay-water subsided leaving the water perfectly clear.

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* See also Contributions a l'Etude de la Chimie Agricole Par Th. Schlœsing, pp. 80–87, where a method for the "physical analysis" of soils is described, differing in various points from Grandeau's statements.

The sand and clay thus obtained were ignited and weighed and their sum represented the "sand" obtained according to Grandeau's directions.

This "clay" obtained according to Schlœsing's method was worked over in the same manner, in order to remove from it as far as possible the fine sand which the microscope showed it to contain. From this "clay" there was thus separated 8·99 per cent. of fine sand.

The following statement of the analysis shows the result of the foregoing treatment.

H corrected.

Carbonate of lime		4.20
Sand	Sand	63.31
	Clay	1.60
Clay	Sand	8.99
	Clay	13.66
Humus		None
Loss on ignition		6.60
		98.36

The clay thus separated still appeared to contain some very fine sand (below ·002^{mm} diameter) from which it could not be freed by mechanical means.

This analysis is, in most respects, not comparable with those made on the same material by other methods, but as the corrected Berlin-Schöne elutriation, G. 1, made on a sample boiled one hour, gave but 3.92 per cent. of clay, it would appear that, of the 15.22 per cent. of clay here found, a considerable proportion must have resulted from the breaking up of concreted material by the treatment with hydrochloric acid.

With the prairie soil Schlœsing's method yielded the following results.

PRAIRIE SOIL. MERCER CO., ILL.

J.

Schlœsing's Method.

Carbonate of lime	.88
Sand	82.86
Clay	7.86
Humus	1.57
Loss at 150° C.	4.42
	97.59

The clay in this case contained very little sand which could be separated from it and in this respect the determination was satisfactory. The sand was elutriated by the beaker method and yielded a considerable amount of "clay" as determined according to Hilgard's conventional process. The complete elutriation of this sand may be compared with a similar elutriation of the same soil without previous treatment with acid and shows that the textural character of this soil is considerably changed by the action of dilute acids.

PRAIRIE SOIL, MERCER CO., ILL.

J. Schloesing's Method.		XIV. Beaker Method.		Schloesing's Sand. Dried at 150° C.	Schloesing's Sand. Ignited.	Original Soil. Ignited.
Carbonate of Lime,	.88					
Humus,	1.57					
Loss at 150° C.,	4.42					
Sand,	82.86	Above .25mm		.12	.10	.92
		.25–.05		3.58	3.55	2.89
		.05–.01		42.69	41.87	42.86
		.01– .0	.01-0	23.66	20.47	31.44
			Clay*	12.81	10.14	
Clay,	7.86					7.40†
Loss on ignition,						14.49
	97.59					100.00

The figures indicate that the treatment with acid has disintegrated the particles of less than .01mm diameter so that one-third of this portion would appear as clay, according to the Hilgard method of estimating clay, which we have usually employed.

As to humus it may be noted that the loss in the analysis by Schloesing's method, viz: 2.41 per cent., plus loss at 150°—4.42 per cent. plus humus found—1.57, plus carbon dioxide ($\frac{44}{56}$ of .88=).69, amounts to 9.09 per cent., while the loss on ignition which represents humus, carbon dioxide (?) and water is 14.49 per cent. The 5.40 per cent. difference must evidently be, for the most part, humus which has escaped estimation by the Schloesing method, having been distributed among the sand and clay.

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* Determined by 24 hours subsidence. Chiefly fine sand.

† By difference.

Schloesing, in the *Encyclopédie Chimique*, directs to calcine the sand and thus to determine as " organic *debris* " the relatively bulky vegetable matters separated by sifting or found in the coarse sand. The humus in the clay is not determined nor taken account of in the method of " physical analysis " there described.

The humus determined in analysis J, is in fact humic acid, or that part of the dead vegetable matter, which, in the soil, exists chemically united to earthy and metallic bases in forms that are highly insoluble in water but are decomposed by hydrochloric acid.

The mechanical disintegration that has resulted from the chemical action of hydrochloric acid followed by that of an alkali, in case of this soil has been due to decomposition not only of carbonates, but also and perhaps in a greater degree, to that of humates.

THE MECHANICAL DETERMINATION OF CLAY.

Schloesing's method for the separation of clay is essentially one of subsidence for 24 hours from a solution of 200 to 250^{cc} volume, but of no specified height. Hilgard's conventional method requires the same time and a height of solution of 200^{mm}.

Such methods of separation assume, first, that most of the sand and second, that little of the clay shall settle within the fixed time. That both of these assumptions are fallacious, the following experiments show. The " clay " obtained by 24 hours subsidence from 30 grams of brick clay was suspended in four liters of distilled water and allowed to settle out completely, which required several days. The water was then decanted off so as to remove all soluble matters, the jar again filled with distilled water and the clay and fine sand allowed to settle again for several days. The upper three-quarters of the liquid were then decanted and made up to a volume of four liters, and this was allowed to stand several days when a considerable sediment had formed. A decantation was again made as before. The operations were repeated until the clay water had been so far freed from the clay as to become opalescent; then it first ceased to deposit any appreciable sediment. A microscopic examination of the several sediments thus collected showed them all to contain particles of sand. It appears, therefore, that only after the liquid containing the clay has become opalescent does it cease to deposit fine particles of sand as well as clay.

Furthermore, the character of the true clay itself is so changed under certain conditions that it loses the property of remaining in prolonged suspension in water.

A sample of clay which had been freed from particles of sand exceeding .005^{mm} diameter was suspended in water and precipitated from it by freezing. It was then washed by decantation with alcohol and dried in the air. A portion of this clay was shaken up with water and allowed to stand a few hours, during which time the greater part of it had settled. After decanting off the water and suspended clay and repeating this process a few times a very considerable part of the clay was left which would subside completely through 100^{mm} in a few hours. After standing under water for several months, only a small part of the clay had regained the quality of prolonged suspension. It was found, however, that if this clay were pestled this quality of prolonged suspension was restored to it to a very considerable degree.

It is evident, therefore, that conventional methods depending on simple subsidence can give no accurate results because the very varying amounts of finest sand and clay in different soils will yield very variable mixtures of the two when subjected to any simple course of treatment by elutriation and subsidence.

The method of persistent pestling and repeated subsidences and decantations continued until no further separation can be effected, although extremely tedious, is the only one which has as yet yielded even approximately good separations on any of the clayey soils I have hitherto examined.

A single subsidence of the clay water for 24 hours will free it from all particles of sand having a diameter greater than .005^{mm}, but in many cases a considerable amount of finer sand will remain in suspension for many hours or days.

On the other hand, the sediment formed during the twenty-four hours subsidence will not be free from clay, as may be easily seen by suspending it in water a second time and allowing it to stand again for twenty-four hours. Both Hilgard and Schloesing direct attention to these defects, but assume that they do not usually influence the results to a sufficient extent to deprive them of value. In many cases this is undoubtedly true, as for example, in such soils as that from the Garden of the Experiment Station in which there is but little clay and fine sand, but in soils of the opposite character as in the North Haven brick clay where exact separations are most desirable, a very considerable error is thus inevitably encountered.

EFFECT OF BOILING ON THE TEXTURE OF CLAYEY SOILS.

Most investigators who have worked upon mechanical soil-analysis advise boiling with water in order to detach "clay" and "sand" from each other and make good separation of the several mechanical elements practicable or possible. In general, however, the instructions as to the time and manner of boiling are rather indefinite, and no proper research as to the effects of this treatment has been undertaken.

The practice of Prof. Hilgard, to boil 24 hours or even longer in case of adhesive clays, would appear to be objectionable in view of the dehydration and change of physical properties known to occur in case of many hydroxides, especially those of iron and aluminum, which occur or may occur in the soil. It is a familiar fact to the chemical student that the hydroxides above named and many other amorphous substances when precipitated from cold solutions are more bulky and less easily washed upon a filter than when thrown down hot. It is also well known that their properties are considerably changed by warming or boiling with water, and St. Gilles,* Davies† and Rodman‡ have shown that heating with water to boiling for some hours or days gradually converts the bulky brown-red ferric hydroxide, which when precipitated cold and air-dried for 18 days Carnelley and Walker§ found to contain 38 per cent. of water, into a much denser bright-red substance containing but two per cent. of water. St. Gilles has also observed the partial dehydration of aluminum hydroxide (from $Al_2O_3 . 5H_2O$ to $Al_2O_3, 2H_2O$) by prolonged boiling.

The hydrates of silica and the highly hydrated silicates are most probably affected in a similar manner, and if such be the case, boiling would evidently change the constitution of clay in a very essential degree.

The following experiments were undertaken to throw light upon this question:

10 grams of North Haven Brick Clay were boiled continuously for nine days in a glass flask of 1 liter capacity, with about 700^{cc} of distilled water and reflux condenser.

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* J. pr. Chem., lxvi, 141.

† Chem. Soc. J. [2], iv, 66.

‡ Am. J. Sci., xliv, 1867, p. 222.

§ Chem. Soc. J., Jan. 1888, pp. 76.

15 grams were boiled in the same manner for eight and one half days. When the boiling was concluded the soil was found to have assumed a granular condition, the clay and fine sand being collected into a mass of small grains resembling coarse sand which settled rapidly. One portion thus boiled was elutriated by the Beaker method, the other by Hilgard's. The pestle was not used on either of those portions as it was desired to determine simply the effect of prolonged boiling. The separations thus accomplished are here compared with the elutriations of the same soil boiled 23 hours and of the pestled but unboiled soil.

BRICK CLAY, NORTH HAVEN.

Effect of long Boiling (in glass).

	Hilgard Elutriation.		Beaker Elutriation.	
	Not pestled.			Pestled.
	Boiled 23 hrs. XII.	Boiled 9 days. XVI.	Boiled 8½ days. No. 40.	Not boiled. No. 27.
Sifted	3.36	3.24	3.63	3.49
.25–.05	1.21	1.11	1.91	1.29
.05–.01	28.27	33.04	33.61	27.02
.01–0	56.29	48.85	54.78	52.21
Clay	4.92	3.05	1.97	10.15
Loss on ignition	5.95	5.95	5.95	5.95
	100.00	95.24	101.85	100.11

Here it is observed that the 8–9 day's boiling diminished the clay as determined by Hilgard's conventional method by 7–8 per cent., increasing the "dust" by 2–3 per cent. and the "silt" by about 6 per cent.

Under the microscope small, rounded, opaque, brown granules were seen in large numbers, which when pressed under the cover-glass broke up into a multitude of very fine particles.

Unfortunately the sample was exhausted by these analyses and the experiment could not be repeated so as to correct the considerable error indicated by the loss in XVI.

From these experiments it would appear to be conclusively proved that too long boiling precipitates clay and thereby defeats the very object of the operation.

In these experiments the time of boiling was prolonged in order to bring out unmistakably the effects of this operation. If ebullition for 8 or 9 days reduces "clay" from 10 to 2–3 per cent., increasing the .05–.01^{mm} grades by 6 per cent., it is evident that boiling for one day or a shorter time becomes a questionable treatment. In the analyses made by the use of Hilgard's churn elutriator, published in my former paper, it is easy to trace the effect of boiling. This very Brick Clay boiled for 23 hours is shown by analysis XII above quoted, either to have come short of sufficient disintegration in the .05–0 sediments, or if sufficiently disintegrated, to have suffered subsequent precipitation of half of the clay with those sediments.

The comparative analyses of Prairie Soil given in my former paper lead to the same alternative. The Hilgard elutriation, after 23 hours boiling, XIV (Report of this Station for 1886, p. 157) yielded less of clay by 2 per cent., less of .01–0^{mm} by nearly 5 per cent., and more of the two coarser grades by 7 per cent. than the Beaker elutriation on unboiled soil.

Whether this precipitation on boiling is simply due to dehydration by heat or is partly or wholly attributable to the action of salts extracted from the clay or from the glass of the vessel, further experiments in metallic vessels, which are already in progress, may decide.

When the clay has once been converted into the "granular" condition considerable difficulty is experienced in restoring it to the state in which it is capable of prolonged suspension in water.

The results of the studies herewith reported may be summed up as follows :—

1. The Berlin-Schöne method of elutriation gives fairly correct separations with sandy soils containing little clay or matters finer than $.01^{mm}$, but on fine-textured soils, as loams rich in humus and clays, it gives results which are grossly inaccurate, the error on single grades amounting to 8–14 per cent.

2. In respect to rapidity, economy of time and ease of operating, the Schöne elutriation has no advantage over the Beaker method.

3. Schlöesing's method on its mechanical side makes no satisfactory separations, and the chemical treatment it employs is liable seriously to alter the texture of the soil.

4. The determination of "clay" by a single subsidence from any conventional volume or depth of water, or for any conventional time, is not a process certain to effect even a roughly approximate separation of the finest quartz grains from true clay.

5. Boiling with water must be rejected as a treatment preliminary to mechanical analysis, because it not only abrades and reduces the coarser sediments, but dehydrates and coagulates the true clay and thus essentially alters the texture and grain of the soil.

In a paper "On the Methods of Mechanical Soil Analysis," published in the "Proceedings of the Eighth Annual Meeting of the Society for the Promotion of Agricultural Science, 1887, pp. 48–50, Prof. E. W. Hilgard states his objections to "the subsidence method or 'beaker elutriation,'" and explains the reasons which formerly induced him "to reject this same method." Prof. Hilgard further says, "After obtaining an insight into the grave difficulties involved in the hydraulic process my first thought was to avoid them by using the obvious and simple method of subsidence, and I thus went very fully over the ground covered by Dr. Osborne's work," and again, "So far the only difference between Dr. Osborne's plan and mine is that he proposes to treat, also, the larger sized sediments ($>$·28^{mm} hyd. value) by the subsidence method.

But Prof. Hilgard has overlooked the fact that the older "subsidence methods" differ essentially from the process which I have proposed to distinguish as "beaker-elutriation" in one very important and characteristic particular.

Prof. Hilgard says that his objection to the "subsidence method" is "simply that life seems to me too short to be occupied in painfully watching the second-hand of the watch up to the decisive moment when a short paroxysm of precipitate activity ensues, to be again succeeded by a period of enforced idleness and patience-trying watchfulness."

In my first paper (Report of this Station for 1886, p. 142), I stated nearly at the outset that "it shortly became evident that nothing is to be gained by limiting sedimentation arbitrarily to any particular intervals of time and space," and I would repeat that my process does not, as Prof. Hilgard appears to suppose, require any "close observance of the times corresponding to grain sizes," but that the eye and the micrometer alone decide the results of separations and indicate the times and the number of the subsidences, which are simply repeated until a desired result is attained and all with as much freedom to the operator as is permissible in carrying on hydraulic elutriation, or the ordinary work of the laboratory. In fact, if I am able to judge impartially, the actual consumption of time and nerve in hydraulic elutriation, including the preliminary boiling, the handling of large volumes of distilled water, and of clay-water, and the use and care of delicate apparatus, is no less than in beaker elutriation.

THE STATION FORAGE GARDEN.

How to improve Connecticut grass-lands so as to make them more productive and also more permanent (wherever that is desirable), are questions of the first importance. To answer these questions we need for one thing, to know more about the hardy grasses and forage-plants which grow in our state with less care than others and no expense for seeding; their habits of growth, seed production, fitness for meadow and pasture on different soils, feeding value, rooting peculiarities, growth with other varieties, possible improvement by cultivation or by selection of seed, the effect of different fertilizers, etc. We need, also, to secure a more general and a closer observation of the appearance and behavior of all our useful grasses, so that they may be known by botanists as well as by farmers, at sight, through the spring, summer and fall. We need to have names for them which shall pass current every where, free from all confusion; because without names there can be no discussion of grass away from the grasses themselves. Only by a general improvement in these respects can the literature of our agricultural grasses become satisfactory or as widely useful as the welfare of the State demands.

Botanists at present have for their ready information books and collections of carefully dried plants usually gathered when in flower or fruit, each labeled with its scientific name. To identify a specimen botanists require to see it either in flower or fruit. Agricultural botany needs to go further than this ; to read the sod like a book and identify with certainty the common grasses at all stages of growth from spring to fall. The botanist's herbarium is not enough for this. We must have the planted as well as printed page. There are needed for reference, as keys to our door-yards and farms, collections of growing grasses, to show as the season advances, their foliage, flowers, seed and general appearance. These when properly labeled, will enable a good observer without any special knowledge of botany to name almost any grass which grows in this State. Such a collection has been gathered at this Station during the last eighteen months to serve as a starting point, we hope, for other collections throughout the

State. Many of the difficulties in the way of starting, especially in procuring seeds and plants, have been overcome here and need not be encountered by others. It is hoped that many farmers will join the Station in its closer study of forage plants. To learn the names of a considerable collection in the home garden or at large on the farm can scarcely tax the memory more than a teacher is taxed in learning the names of scholars the first week of school.

The Station was fortunate at the outset in having the services of Mr. James B. Olcott, of South Manchester. The success of the undertaking has been largely due to Mr. Olcott's special knowledge, to his energy and persistence in securing specimens of seed and growing plants, and to his advice and personal services in the garden itself.

Seeds of grasses for the garden have been collected where possible, in and about New Haven by ourselves. Messrs. Vilmorin, Andrieux & Co., of Paris, Peter Henderson & Co., of New York, and R. D. Hawley, of Hartford, kindly supplied us with seeds ordered from them, without charge. From J. J. Wolfenden of New Berne, N. C., we received a package of seeds of the Cow Pea. A collection of sods of western grasses was kindly sent to us by A. Gilchrist, Esq., of Cheyenne, Wyoming. Prof. E. M. Shelton of the Kansas Agricultural College, and Carlos Reese, Esq., of Marion, Ala., both favored us with seed and sod or roots of Texas blue-glass [*Poa arachnifera*]. To the New York Experiment Station we are also indebted for a gift of seed. To Dr. Vasey, Botanist of the U. S. Department of Agriculture, our special thanks are due for both seeds and sods of a number of western and Mexican grasses from the Department gardens as well as for frequent favors in identifying species.

The U. S. Department of Agriculture also supplied us with seeds of a considerable number of forage plants, most of which proved very satisfactory.

Seeds of the grasses were planted in drills, seven feet long and from 18 to 24 inches apart, and were usually covered half an inch deep and the earth was moderately compacted over them. Those which it seemed desirable to have also in sward, were sown in plats 7 feet long by 5 feet wide, raked in and rolled with a light roller.

If the weather was dry after planting they were lightly mulched with corn stalks, salt marsh hay or tobacco stems. The tenderer grasses were also mulched lightly late in the winter when the snow was going, to prevent the tearing of their roots by the frequent thawing and freezing. In November of 1886, 45 sods collected by Mr. Olcott, in the neighborbood of Hartford, all of them correctly labeled, were received for the garden. These, with one or two exceptions, did not suffer by transplanting but furnished more satisfactory specimens the following summer than any from the fall sowing of seeds. Others have from time to time sent in sods and seeds to be tested in the garden. During the Spring of 1887, Mr. Olcott, at our request, visited Rhode Island and made a study of "Rhode Island Bent" both in the seed pastures and meadows and in the seed market, sending specimens of the trade seed and of the sods from many different places, for observation in our forage garden. He subsequently made a partial survey of this State with the same objects in view. A paper by Mr. Olcott, on Fine *versus* Coarse Agrostis, will be found in the following pages.

By constant care each drill and plat has been kept entirely clean of all weeds or grasses other than the one specially planted. A special set of thrust and bayonet hoes made for us by the Collins Co. from Mr. Olcott's models, has alone made this possible with the limited time that could be given to the garden. Our experience proves that for the greatest convenience in weeding, the drills should have been one foot shorter and the plats one or two feet narrower.

The total number of sods now in the garden, many of them duplicates of the same species, is 650, of drills there are 163 and of plats 56.

The garden contains 81 out of the 120 species of grasses which grow without care in this State, and besides, some thirty species of grasses which do not occur wild in this State. Besides grasses, there are grown clovers, vetches and lupines as well as some of the more interesting sedges, which furnish a part of our hay and grazing. All these kinds of plants are proper subjects of recognition and study, whether they prove useful or not. Thus far the work in the forage garden has been chiefly devoted to securing specimens of grasses and seed true to name. Certain experiments have been commenced but results are not yet ready for discussion.

We only note here one or two observations made incidentally in our collection of specimens and seed. Attention is also called in this connection to the analyses of certain grasses given on page 100. To ascertain the present state of the seed market in Fine Bent, Rhode Island Bent seed was ordered by us from 10 of the prominent seedsmen in New York, Philadelphia and Boston. Six lots only were obtained, four of the firms not being able to supply it. These lots were sown in plats rather late in the season and blossomed very sparingly. It was evident however that only two of them contained any considerable quantity of "Fine Bent," the others were chiefly "Coarse Bent"—the ordinary trade red-top.

Of the samples of wheat sent by the U. S. Department of Agriculture, those bearing the following labels did well.

Martins' Amber.
Four-rowed Sheriff.
Diehl's Mediterranean.
McGee White.
Raub's Black Prolific.
German Emperor.
Fulcaster.

The last two varieties made the heaviest growth. Genoese and White Crimean winter-killed badly.

Indian and Extra Early Oakley sprouted very feebly.

A sample bought for *Festuca pratensis*, Meadow Fescue, proved to be *Lolium perenne*, or English Rye Grass with perhaps a little Italian Rye Grass.

A sample of *Anthoxanthum odoratum*, or Sweet Vernal grass proved to be Var. *Puelii* which is an annual plant much inferior to the perennial Sweet Vernal. It is extensively sold for the more valuable variety.

A sample of "Superior Rhode Island Bent" proved to be chiefly tall Red-top, not Rhode Island Bent, or fine Red-Top at all. The same was true of a sample of trade "*Agrostis canina.*"

A sample bought for *Avena elatior* or tall Oat grass, proved to be a mixture of *Bromus secalinus* or Cheat or Chess, *Dactylis glomerata* or Orchard grass, much *Lolium perenne* or English Rye grass and some *Avena elatior.*

A sample bought for *Poa annua* or Annual Spear grass proved to be another *Poa*, which has not yet been identified.

Another sample bought for Sweet Vernal grass contained a large quantity of seed of a handsome, but agriculturally worthless, annual grass, *Apera spica-venti.*

A sample of "Hard Fescue," *Festuca duriuscula*, proved to be about half Hard Fescue and half Sheep's Fescue.

The Southern Cow Pea has grown very vigorously in the garden, furnishing a large amount of forage and ripening its seed before frost.

It is noteworthy that *Phalaris arundinacea* or Reed Canary-grass, the *Glycerias* and certain sedges, notably *Carex vulgaris*, which are wet-land or marsh grasses, made excellent growth in our garden soil. It may be that these and other grasses if freed from competition with other plants or from the grazing of cattle would thrive as well in dry as in wet places.

From these notes it is evident that the trade in pure seed is not in a satisfactory state and that fresh seed true to name for a garden like ours must be collected by those in charge, for it cannot be bought with any certainty as to quality. This fact was fully appreciated at the outset and we have only bought seed when it was impossible to get it otherwise. We have now gathered from our own garden, as the list on page 173 shows, small quantities of seed from many species of grass which is true to name. The Station will be glad to receive from any source seeds or sods of grasses not in this list, and to exchange for them any sod or seed which it has in surplus. To the extent of its ability it will aid any institution which has such work in prospect. It will also continue to receive from citizens of Connecticut plants for identification as explained in Bulletin No. 91.

The Station is also always prepared to examine for farmers seeds of grasses or of vegetables with reference to their purity and vitality as explained in the Report for 1883, page 105.

How the practical information which the Station garden offers can best be distributed through the state is an important question. Personal visits to the garden will certainly be profitable alike to the visitor and to those in charge of it, favoring an exchange of knowledge on the subject. The Station can supply to a limited number of Granges, Farmers' Clubs or Schools small collections of named grass-seeds for planting if they are desired. Should sufficient interest be awakened it could perhaps arrange to send by mail whole plants for inspection and study as they come into bloom through the season. The recommendation of the Dairymen's Association made at its recent meeting that Agricultural Societies offer small premiums for the best collections of named grasses is a step in the right direction.

The following pages of explanations are here repeated, with some minor changes, from Bulletin No. 93 of this Station.

ON THE CLASSIFICATION AND NAMING OF PLANTS.

To aid in understanding the plan by which men of science have classified and named grasses and other plants, the following explanations are offered.

It is evident at the outset that in order to describe a plant exactly words must be used which have as far as possible a strictly definite and unmistakable meaning. Botanists acting on this principle have adopted certain words which they employ in their classification of plants. Such words are *variety*, *species*, *genus*, and *family*. In the following pages we have endeavored to give the sense in which the botanist uses some of the more important of these terms, believing that the farmer also will find great benefit in their scientific use.

A Species is intended to include all individual plants which are very closely alike in form, structure and manner of growth, and which steadily reproduce plants which are like the parents in all these particulars. For instance there is a species called the white oak (*Quercus alba*). The leaves of every white oak tree have a general oblong or egg shape, but are cut into 3 to 9 oblong or linear lobes, having no pointed tips, smooth, of a bright green color above and pale below. All white oaks bear their acorns in the fall, on wood of the same year's growth, the cups of these acorns are rough, hemispherical, and much shorter than the acorns themselves, which are oblong. No other oak but the white oak has all these peculiarities of structure and growth. The white oak cannot be confounded by any one who knows these facts, with the red oak, or the shrub oak, or the swamp white oak which are three distinct species. Moreover from the acorns of the white oak only a white oak will grow, never a swamp white oak, shrub oak or red oak. The white oaks are related by a kind of common origin which the other oaks do not have in common with them. Another distinguishing mark of a species is the power of continued reproduction between individuals belonging to it. All white oaks cross-fertilize, i. e., the pollen from one white oak tree will fertilize the pistillate flower of any other white oak tree, whereas it would not fertilize the pistillate flower of another perfectly distinct species of oak. Among grasses, Hungarian grass (*Setaria Italica*) is one species and the yellow foxtail (*Setaria glauca*) is another and related species. The differences between these two [species differences or *specific* differences] are well known to many farmers.

Varieties.—Individuals of the same species while very closely alike differ from each other more or less. Circumstances of soil, climate, etc., increase these differences and varieties originate when such differences assume a *comparative permanence and fixity.* But as external conditions cause variations away from any particular representative of a species, so they may cause variation back again to the original, and although variation may take a seemingly wide range, its bounds are fixed and do not touch specific characters. Among plants varieties may often be perpetuated by the seed. This is true of our cereals and leguminous crops, which reproduce their kind with striking regularity. The Tom Thumb, Marrowfat and Champion of England peas, for instance, are all varieties of one species which are reproduced true to the seed. In case of certain other plants, particularly those in which there is abundant chance for a mixing of pollen, favorite varieties cannot be, or are not, certainly reproduced unalterably by the seed.

Red-top [*Agrostis vulgaris*] has two agricultural varieties as distinct as the Tom Thumb and the Champion of England Pea: Tall Red-top which grows 24–30 inches high, blooms a week later than the other variety and has a coarser foliage; Fine Red-top or, Rhode Island Bent, which grows 12–15 inches high, blooms earlier and has a much finer foliage. Both are reproduced true from seed. We also find forms intermediate between these two which evidently belong to the same species although they cannot always be classed with one variety rather than the other.

Genus.—All the different species of oaks have a general family resemblance noticeable by any one, and certain common characters, chiefly in their flower and fruit, which distinguish them from all other trees. This group of closely allied species makes a *genus* [plural, *genera*]. So we have the oak genus [*Quercus*] including the white oak, the chestnut oak, red oak, etc. In like manner we have the Red-top genus [*Agrostis*], which includes our common varieties of Red-top, already spoken of, besides fiorin [*Agrostis alba*], about which English grass books say so much, Brown Bent or Dog's Bent [*Agrostis canina*], and the Thin grass [*Agrostis perennans*], which grows in shady places, etc. The Timothy genus [*Phleum*] includes both our eastern

Timothy [*Phleum pratense*], or English grass and the Mountain Timothy of the west [*Phleum alpinum*].

Families.—The genera themselves are grouped into families. Thus the oaks, chestnuts, beeches, hazels and hornbeams, all belong in one family, the *Cupuliferæ* or cup bearers, so called because each fruit, a nut, is borne in a cup shaped receptacle. So too the genera *Agrostis* and *Phleum*, and all other grasses belong in the one family of *Gramineæ*, whose aspect and characters are well known.

NAMES OF GRASSES.

In order to speak or write intelligibly of plants it is necessary to have a name for each which shall be commonly and perfectly understood and which shall apply to one species and only one. Following the method first proposed by Linnæus, "the father of botany," it was long ago agreed to give to each species of plants two names, one, the first, being the name of its genus, the second the species name; and in order that the same name might be used by botanists of all lands the Latin form was used, that being the nearest approach to a universal language. The name is given by the botanist who first identifies or classifies the plant and his name or initials are often put after the name which he gives. *Quercus*, as we have already seen, is the name of the oak genus, as distinguished from the hickory or chestnut genus, *alba* is the species or specific name and distinguishes the white oak from the red oak, live oak, post oak, etc. While the name white oak is recognized only where the English language is spoken and even there is liable to be confounded with the swamp white oak, which is a very distinct species, the name *Quercus alba* is understood by botanists all over the world. But it sometimes happens that after a plant supposed to be new has been named, it appears that it had been previously described and differently named by some one else. In such cases, to avoid all confusion, the invariable rule is to use the name first given.

These then are the names found in our standard botanical books. The objection to their common use is that they are in a strange language and sometimes long. They are hardly stranger, however, than "nitrogen," "available phosphoric acid," and "actual potash" were to most farmers a few years ago. The advantage of these names is that they avoid confusion and make intelligible our discussion of botanical matters. To illustrate: "Poverty grass" is a common grass, frequently spoken of among farmers, but this name is commonly applied to at least two very distinct species, viz: *Danthonia spicata*, which grows only in a very poor soil and is of no value as forage, and *Andropogon scoparius*, which also grows on poor sandy soil, but in some places makes valuable feed. This last is also called "broom sedge," whereas it is a grass and not at all a sedge. "Blue Stem" and "Blue Bent" are names of one of our best native grasses, *Andropogon provincialis;* "Blue Joint," which is dangerously like "Blue Stem," is the name of a grass very different from the last, viz: *Deyeuxia Canadensis.* "Wood grass" is applied to *Chrysopogon nutans*, a coarse but good forage grass, and to *Muhlenbergia Mexicana*, which is totally different in appearance and value. Now "Poverty grass," "Blue Stem," "Blue Bent" and "Wood grass," are indefinite terms, but *Danthonia spicata*, *Andropogon provincialis*, *Muhlenbergia Mexicana*, etc., can never be confused, since these names are used by all botanists and in their writings the peculiarities of these grasses are accurately and fully described. In the list of names of grasses on page 174 of this Report will be found both the botanical and colloquial names of the commonest grasses, which will illustrate these points and will also explain the meaning of some botanical names.

We believe that a better knowledge of our Connecticut grasses, of their habits of growth and forage value, is one great need of our agriculture. But the first step toward getting and spreading that knowledge must be to have names for the more useful ones, which shall be so definite that no one will misunderstand them, and which shall not be so difficult or uncouth that intelligent men will not use them. At present we have no such names *in common use* among us. There are not more than three or four grasses in this State whose common English names are generally used throughout the State without confusing synonyms which are also applied to other grasses. These are Timothy, Red-top, June-grass and Orchard-grass. Even Red-top applies to two grasses agriculturally distinct, and June-grass is a name quite generally used without the knowledge that it is the same as Kentucky Blue-grass. Yet there are at least eleven important meadow grasses which are mowed in large quantity every year in the State, and at least six others which are common and valuable pasture grasses, to say nothing of a number of less common but very useful ones and of the sedges, some of which are valuable. We have then on the one hand Latin botanical names which are tolerably free from confusion, and on the other hand common English names which are very much confused and indefinite. The former are not familiar and are, perhaps, harder to learn than the latter. The question is, can they and will they be learned by intelligent farmers? If not, can English names be agreed upon for all our common grasses which shall be as definite and free from confusion as the botanical names, and can they be brought into common use? A revision of the grass nomenclature now in common use, like the revision of pomological names which is at present going on, is very desirable. Till it is accomplished, the Station, to be accurate and clear, can only use the botanical names, supplying where possible the best common names, as on page 174 of this Report.

The following list includes all grasses which have grown in the Station Forage-garden during the present season. The annual grasses of course, at this time, are dead, and have been sown again for next year. An asterisk (*) before the name of a grass denotes that we have at our disposal, for exchange, a few young plants or sods; a dagger (†) in the same position denotes that we have seed for exchange. The quantity which we propose to exchange will be but quite small, in most cases only sufficient for a drill seven or eight feet long; enough, however, to show the characters of the grass, and to yield seed next year for a larger sowing, if that is desired. The seed we believe to be sound, strictly pure and true to name, most of it gathered in this garden and by our own hands.

GRASSES IN THE GARDEN OF THE STATION.

Agropyrum caninum. [*Triticum caninum of Gray's botany.*]
divergens.
† **glaucum.**
† **repens.** [*Triticum repens of Gray's botany.*]
† **tenerum.**
Agrostis exarata.
*† **perennans.**
† **scabra.**
*† **vulgaris, var. major.**
*† **vulgaris, var. minor.**
*† **var. alba ?**
*†**Alopecurus pratensis.**
†**Andropogon dissitiflorus.** [*A. Virginicus of Gray's botany.*]
† **provincialis,** [*A. furcatus of Gray's botany.*]
*† **scoparius.**
†**Anthoxanthum odoratum.**
† **var. Puelii.**
†**Apera spica-venti.**
†**Aristida purpurascens.**
purpurea.
*†**Arrhenatherum avenaceum.**
*†**Asprella hystrix.** [*Gymnostichum hystrix, of Gray's botany.*]
*†**Avena flavescens.**
†**Boutiloua olygostachya.**
*†**Bromus brizaeformis.**
† **ciliatus.**
* **inermis.**
* **pratensis.**
*† **Schraederi.**
*† **secalinus.**
† **segetum.**
*† **tectorum.**
[Carex stricta.]
[tentaculata.]
* **[vulgaris.]**
†**Cenchrus tribuloides.**
†**Chrysopogon nutans,** [*Sorghum nutans of Gray's botany.*]
†**Cinna arundinacea.**
Cynosurus cristatus.
[Cyperus Michauxianus.]
*†**Dactylis glomerata.**
*†**Danthonia spicata.**
Deschampsia caespitosa.
† **flexuosa.**
† **pulchella ?**
†**Deyeuxia Canadensis.** [*Calamagrostis Canadensis of Gray's botany.*]
Diplachne fascicularis, [*Leptochloa fascicularis of Gray's botany.*]
Eatonia obtusata.
Eleusine Indica.
Elymus Canadensis.
*† **Virginicus.**
†**Eragrostis capillaris.**
*† **pectinacea.**
† **pilosa.**
† **poeoides, var. megastachya.**
Erianthus Ravennae.
Eulalia Japonica.
var. variegata.
***Festuca duriuscula.**
† **pratensis.**
heterophylla.
nutans.
* **ovina.**
* **var. tenuifolia.**
var. rubra.
† **tenella.**
†**Glyceria aquatica. var. Americana.**
† **Canadensis.**
nervata.
†**Holcus lanatus.**
Hordeum jubatum.
Leersia oryzoides.
Virginicus.

*†Lolium perenne.
*† var. Italicum.
* var. tenue.
Muhlenbergia capillaris.
† diffusa.
*† Mexicana.
Willdenovii.
†Panicum agrostoides.
† capillare.
clandestinum.
† crus-galli.
† var. hispidum.
dichotomum.
filiforme.
glabrum.
† latifolium.
† miliaceum.
proliferum.
† sanguinale.
† virgatum.
Paspalum setaceum.
*Phalaris arundinacea.
*†Phleum pratense.
Phragmites communis.
Poa annua.
* arachnifera.
*† compressa.
Nevadensis.
* pratensis.
*† serotina.
trivialis.
Reana luxurians.
†Setaria glauca.
† verticillata.
† viridis.
Sorghum halapense.
Spartina cynosuroides.
Sporobolus depauperatus.
† heterolepis.
Stipa pennata.
spartea.
*†Triodia seslerioides. [*Tricuspis seslerioides, of Gray's botany.*]
*Vilfa vaginaeflora.
aspera.

Since these botanical names are not familiar to many, there follow here by way of explanation, the botanical names of the more common agricultural grasses, their pronunciation indicated by accents, and their derivation given as far as that is possible. With each are given, in lighter type, the colloquial or provincial names by which they are sometimes known. As yet we have no really common names.

BOTANICAL AND COLLOQUIAL NAMES OF GRASSES.

Agropyrum répens, formerly called *Triticum repens*, [*Agropyrus* = field wheat, *repens* = creeping.] Couch-, Quitch-, or Quick-grass, Quack, Twitch- or Dog's-grass, Dutch-grass, Durfa, Devil's-grass. Grows through potato tubers!

Agróstis scábra, [*scabra* = rough.] Hair-grass.

Agróstis vulgáris. [*Agrostis* = a field, the place of growth, *vulgaris* = common or ordinary; i. e. common field grass.] Red-top, Fine-top, Furze-top, Burden-grass (from its fleece-like burden rolling from the scythe) Bent, Fine Bent, English grass, Rhode Island Bent. These names all apply in different sections to a variety that is twelve to fifteen inches high and blooms a little earlier than another taller variety, which is Tall Red-top. Tall Red-top grows twenty-four to thirty inches high, and is much sown with timothy and clover in short rotation.

The seed of this is now chiefly grown far west. That of the other for lawns should be saved from clean turf in the east as of well-swarded sheep pastures, with no mixture of other grasses.

Alopecúrus praténsis. [*Alopecurus* = a fox tail, *pratensis* = of the meadow.] Meadow Fox tail, "Mountain Timothy" of Montana. Blooms earlier, taller, and with a shorter head than Timothy, moreover the leaves and stems are of a darker and richer green.

Andropógon provinciális. [*Andropogon* = bearded man, the staminate or male flowers often being bearded, *provincialis* = of a province.] Thatch, Finger-spiked Broom-grass, Blue Stem, Blue Bent of Connecticut River meadows.

Andropógon scopárius. [*scoparius*, Latin=sweeping.] Wood-grass. Broom-grass, Broom sedge. The grass of the Wallingford plains.

Andropógon dissitiflórus. Broom sedge. Not a sedge but a grass.

The Andropogons start late in spring and stop growing with cool weather.

Anthoxánthum odorátum. [*Anthoxanthum* = flower of flowers, *odoratum* = odorous.] Sweet Vernal-grass, Sweet-scented Spring-grass. Has bitter foliage but scents the hay.

Arrhenathèrum avenàceum. [*Arrhenatherum* = awned stamen, *avenaceum* = like oats.] Tall Oat-grass. The foliage has a distinctly bitter taste. Early and hardy.

Chrysopógon nútans. [*Chrysopogon* = golden bearded, *nutans* = nodding.] *Sorghum nutans.* Indian-grass, Wood-grass. Starts late in spring and stops growing with cool weather.

Cínna arundinácea. [*Cinna*, name unexplained, *arundinacea* = reed-like.] Wood Reed-grass.

Dáctylis glomeráta. [*Dactylis* = finger's breadth, alluding to the size of the clusters, *glomerata* = crowded together, in allusion to the flower clusters.] Orchard-grass, Cock's-foot-grass, Rough Cock's-foot-grass. Young stems flat at base in fall and spring, and so quite distinct from Timothy. Almost evergreen.

Danthónia spicáta. [*Danthonia*, from Danthoine, a French botanist, *spicata* = spiked.] Poverty-grass. Oat-grass. Spiked wild Oat-grass. White Top.

Deyeúxia Canadénsis. Blue Joint, Small Reed-grass. Grows in wet places and makes good hay.

Festúca ovína. [*Festuca*, the old Latin name for it, *ovina* = belonging to sheep.] Sheep's Fescue. Makes the finest, close sward alone and without manure on suitable soils. Seed in market seems to grow plants which are seedy and bunchy. Remedy may be a return to old pasture seed.

Festúca praténsis. [*pratensis* = of the meadow.] Meadow Fescue. In Conn. we have very little or none of this species growing tall enough to answer the descriptions of *elatior* by English writers. Excellent for rich permanent meadow or pasture.

Glycéria Canadénsis. [*Glyceria* = sweet, in allusion to taste of the grain, *Canadensis* = Canadian.] Rattlesnake-grass, Tall Quaking-grass. Grows in wet places. Cattle eat it greedily.

Glycéria nerváta. [*nervata* = nerved.] Nerved Meadow-grass, Nerved Manna-grass, Fowl Meadow-grass. This name is properly applied only to *Poa serotina.* Makes good hay on wet land.

Glycéria aquática. [*aquatica* = aquatic.] Reed Meadow-grass, White Spear-grass. A wet meadow grass. Quite sweet at base of stalk.

Hólcus lanátus. [*Holcus* = attractive, *lanatus* = wooly.] Velvet-grass, Meadow Soft-grass, Velvet Mesquite-grass. Called "Calf-Kill" in Rhode Island from the rather dry and wooly, innutritious character of the forage, probably.

Leérsia oryzoídes. [*Leersia*, named for Leers, a German botanist, *oryzoides* = like rice.] Rice Cut-grass. Grows in wet places and in rich flowed land gives heavy crops. Fodder value not well known. Rough as a cow's tongue.

Muhlenbérgia Mexicána. [*Muhlenbergia*, named for Muhlenberg, an American botanist, *Mexicana* = Mexican.] Drop seed. Wood-grass.

Muhlenbérgia diffúsa. [*diffusa* = spreading, diffuse.] Drop-seed. Nimble Will.

Pánicum sanguinále. [*Panicum*, an ancient Latin name for millet supposed to come from the word meaning bread, *sanguinale* = bloody.] Common Crab or Finger-grass. A very common annual weed under the lawn-mower.

Pánicum agrostoídes. [*Agrostoides* = like an *agrostis*.] Red-top Panic.

Pánicum virgátum. [*virgatum* = made of twigs or osiers.] Tall Panic-grass, Switch-grass, Long-panicled Panic-grass, Black Bent of Connecticut River meadows. This species like *Andropogon provincialis* and *Chrysopogon nutans* has its foliage injured by frost.

These Panicums like the Andropogons are warm weather grasses.

Phléum praténse. [*Phleum*, an ancient Greek name, *pratense* = of the meadow.] Timothy, Herd's grass in New England and New York.

Póa ánnua. [*Poa*, ancient name for grass or fodder, *annua* = annual.] Low Spear-grass, Annual Spear-grass, Annual Meadow-grass, Goose-grass. Good for rich lawns.

Póa compréssa. [*compressa* = pressed together, flat.] Old English Blue-grass, Wire-grass, Flat-stalked Meadow-grass. Will grow in very dry places, sterile railway banks, etc. Endures the closest grazing.

Póa serótina. [*serotina* = late ripe or backward.] Fowl Meadow-grass, Late Flowering Meadow-grass, False Red-top. Fine hay on wet land.

Póa praténsis. [*pratensis* = of the meadow.] Green or common Meadow-grass, June-grass, Kentucky Blue-grass, Spear-grass. Smooth-stalked Meadow-grass. Excellent for parks and cemeteries. Seed-stalk frequently blasted early in the season. Very common all over Connecticut.

Póa triviális. [*trivialis* = common-place.] Rough-stalked Meadow-grass, Common Meadow-grass. It is scarce and uncommon in meadows except they are old, rich and moist or shaded. Loudon says this, with *P. annua*, are almost the only grasses that will grow in shaded and enclosed places in towns. *Festuca ovina* may have been in Loudon's mind when he wrote "almost."

Zizánia aquática. [*Zizanion* was the Greek name of some wild grain, *aquatica* = aquatic.] Wild Rice, Canada Rice, Indian Rice, Water Oats. Annually reproduces itself, six to ten feet in height, from under water in spring. Blades broad and green as small corn. Seed must be watched for as it falls daily in ripening.

FINE *versus* COARSE AGROSTIS.

By James B. Olcott.

We have been told by botanists that Fine *Agrostis*, Dwarf Red-top, Fine Bent, Furze-top, Burden-grass, and R. I. Bent—all names for the same thing, perhaps—are not to be distinguished, structurally, from Tall Red-top or *Agrostis vulgaris*. This point of *structure* we leave to those who are regulating our botanic system.

But whoever is habitually using and recognizing these forms of Red-top, in farm and garden practice, will deny the identity of the varieties in question. Except that we are inveterate mixers of grass-seeds (though few of us care for grass, only to get enough of it), we should never think of classing them together in any farm catalogue. Because they are no more alike as used by wise farmers and gardeners, than a pony is like a cart-horse.

When seeding plow-lots for a crop or two of hay, we should feel cheated, if a seedsman were to sell us, inadvertently, the smaller, to mix with Timothy, instead of the larger variety of *Agrostis*. On the other hand, when tired of plowing a field, and wishing to seed it so it will run from a meadow into a permanent "butter pasture," perhaps, or a green home-lot, with a fine close sward at bottom, we take much pains to get seed of the smaller grass. Sod of the larger one never tempted spade to lift it, but turf of fine *Agrostis* is a beautiful possession.

Hence—for seeding door-yards, or lawns, where *Agrostis* is preferred, and the best effects desired, the dwarf ones are so much finer in their leaves, stems and roots, that the coarse varieties will never be used in nice gardening for any such permanent purpose. We don't put carpet wools into broadcloth. This is not a treatise upon lawn-making, but parenthetically it may be said here that seedsmen's mixtures, composed of all they recommend for lawns, seem best devised to render uniform, fine texture impossible. We have creeping *Agrostis*, both coarse and fine, in old and well established varieties, preferring, so far as we know, decidedly wet land or wet seasons, and suffering on dry land in dry seasons. The fine one is of value in lawn-making, but to sow it, mixed, on very dry places, would be unskillful, wasteful, contrary to nature, which fitted it to endure wet, and to art which must mind all these particulars to produce a perfect lawn from seed. When farmers learn to grow, dealers learn to sell, gardeners learn to use, and consumers learn to appreciate pure seed, the art of lawn-making and all grass growing will be established on firm foundations. Mixed seeds for the lawn are like mixed colors for the artist, fibers for the factory, and drugs for the chemist—only valuable for purposes to which they exactly apply.

Agrostis, moreover, means *a field*, or *of the field*. This shows the old botanists knew what they were about. Few, if any of this species, bear shade or the drip of trees very well. The place in the door-yard for the *Agrostis*, then, is in the open, trodden, sunny parts of the ground, and plenty of pure seed must be used, where the land is foul with weeds (as it should not be) to produce fair results. Since clean, fine seed is so scarce—at present, indeed, well nigh impossible to find—impure seed has its value for pastures and meadows.

With seed of one coarse *Agrostis* the market is better supplied than ever before in the world. It makes seed freely at the west, and our stock in trade is drawn by train loads from clean fresh lands within two hundred miles of St. Louis. Its pressure on the market is such that it threatens to become more common than the old "common" grazier's Red-top.

Both forms of *Agrostis* are common in Connecticut, and often found growing side by side, one nearly twice as high as the other. Where much plowing is done, the larger variety is apt to prevail. The seed of it, being cheaper, and making tall, coarse hay, is often the only *Agrostis* sown. Where farm animals are brought home nights, from good old pastures, long free from the plow, the seed of dwarf Red-top is frequently scattered widely by cattle, or farm manure, and only for special purposes needs to be bought.

There are thousands of acres of rough pasture sward in every county of the State, largely composed of this old English "Fine Bent." Sheep, if well managed, improve a dwarf *Agrostis* sod, while eating most other kinds of grass out. The connection between fine mutton and Fine Bent seed-growing is natural and practically absolute. Since flocks have disappeared, the fine grass has been overgrown by coarser ones, or with weeds and bushes. Formerly hundreds of bushels of fine *Agrostis* seed were saved from sheep pastures in this State. Now we learn of none being grown for market.

Rhode Island—as nearly as diligent inquiry last spring could determine—is the only source of genuine "Bent" in American trade. Scattering districts and islands, where sheep and painstaking family industries remain together, still produce a scant supply of this valuable seed; though, to say the least, it is sometimes none too clean; but for this fault there are plenty of excuses. From personal examination of the seed-producing districts, we have reason to believe that the product of pure seed—never very large—is now decreasing.

There are reasons for this which should be made public: *First*, botanists have not, generally, recognized the agricultural differences between coarse and fine *Agrostis*. *Second*, there were no positive safeguards against error, either in farm literature, history or tradition. Indeed, much of our literature is misleading. *Third*, buyers, in many cases, have not understood what they needed. *Fourth*, seedsmen, pressed by demand and pinched by supply, grew desperate or unscrupulous, when armed by botanic authority. *Fifth*, growers and land-owners, during the change or decline of eastern agriculture, became careless or helpless in this matter. These conditions, along with general laxity, indifference, pre-occupation and lack of accurate information in things graministic, combined, gradually to bring the much cheaper seed of coarse Red-top, mixed or unmixed, willfully or ignorantly, largely into use in place of the scarcer dwarf *Agrostis*. Many young farmers and gardeners do not recognize the latter, growing at their feet. Unless we have a change for the better in public comprehension, the production of Fine Bent seed for market is on its last legs.

Experiments in growing dwarf *Agrostis* at the far west, have not been successful. Timely rains, as well as close pasturage, and a good soil are required to produce a sod of fine *Agrostis* in several years time. It is a peculiarly wholesome and necessary industry, most in accordance with the genius and circumstances of the east, that is in danger of extinction.

The botanic situation was complicated, some ten or twelve years ago, by the well-meaning efforts of a Providence merchant—assisted by a botanist—to stem the tide of adulteration. This injured his own business and that of seed growers in the Narragansett country, who relied for a living on their sales of fine *Agrostis* seed under the trade name of Rhode Island Bent.

After what he considered a sufficient examination, this worthy botanist declared that the systematic name of R. I. Bent should be *Agrostis canina*, and this name was actually adopted in the lists of several eminent seedsmen.

In seed of R. I. Bent from the best farms, there possibly is, a small quantity—in one case, five to twenty-five per cent.—of still another variety of fine *Agrostis*. This has awns or beards, as wheat or barley is bearded or bald, but we found no seed grower already aware of the awns on his grass. Awned fine *Agrostis* may be *A. canina*, and may turn out to be better fitted, for some purposes, than bald Fine *Agrostis*. But there is not and probably never was enough of it to cover the legitimate seed crop of R. I. Bent with its name. And of course with growers ignorant of it, not enough to hold the market against the substitution, among people who don't mind what they are doing with grass, of the cheaper seed of coarse Red-top.

To stand the racket of trade, botanic distinctions that are vital must be *diffused* among growers, buyers and consumers at least, if not among the entire people, to do any good. This diffusion is the duty of the hour for those who know what botanic distinctions are vital to the lasting interests of honest and wholesome grass seed production and trade.

Leaving other seeds out of the account, there is reason to suppose that consumers of R. I. Bent are paying, on the average, $1 a pound for all the *bald* fine *Agrostis*, and $20 a pound for all the *awned* fine *Agrostis* they are getting. These prices may seem incredible, but considering the magnitude of our door-yard taxes and the sorry results we often secure in lawn-making, it is possible that if the seed were absolutely pure and in expert hands, even at those prices, it might really be cheaper than we are getting it now. Clean seed of the right variety may be spread very thin on *clean*, *rich* land!

Questions in systematic botany we purposely leave for settlement to those who are better qualified to judge than the writer. But the practical relation of fine to coarse *Agrostis* must ever, (let us hope,) be a matter of agricultural as well as botanic testimony. The large form seems to be the result of centuries of selection, seed saving and cultivation, for size of stem, foliage, and especially *for superior yields of seed*, by farmers and seedsmen who were constantly looking for the biggest things. In its seeding qualities this form of *Agrostis* is undergoing the same treatment, in the ripening climate of the far west that our small grains had undergone long before. The grass appears to have grown more seedy and strawy than the original or native type, as the small grains have undoubtedly so changed under the interested hand of man.

The two fine varieties of dwarf *Agrostis*, to which this memorandum is designed chiefly to call attention, we are venturing to believe, are two of the perpetual *peasant* forms of this species. Confident in their own enduring substance, under the best grazing conditions, they produce less seed and more leaves in proportion than forms do that have been long treated especially for seed. The best seed is grown in old pastures, during flush seasons for feed. Some years the seed is not worth harvesting, but the short, thick growth of fine, pointed, radical leaves—the pride of intelligent graziers and gardeners—never fails. One of the ancient farm names for this grass, (the awned form, perhaps,) is "burden grass," because—when mingled with white clover, in rich, moist, old meadow—of the fleece-like burden rolling from the scythe.

With regard to original or native forms of grazing grasses, it may be observed in passing, that characteristics analogous to what have just been mentioned, will be observed in the behavior of certain bunchy and strawy forms of the small fescues, from trade seed, as compared with their more leafy, spreading, and less woody or seedy congeners in old sward.

COMPLIANCE WITH THE FERTILIZER LAW ON THE PART OF DEALERS.

Dealers who have complied with the fertilizer law by furnishing the Director of the Station with the information required in the 4th section:

Alford, G. H.. Winsted.
Apothecaries Hall Co., Waterbury.
Balch & Platt, West Winsted.
Barstow, J. P. & Co., Norwich.
Benton, C. E.. Sharon.
Birdsey & Foster, Meriden.
Blakeslee, Jacob, Watertown.
Brainard, H. K., Thompsonville.
Brownell, E. C., Moodus.
Butler, John L.. Torrington.
Bun, Fred. P. & Co., Middletown.
Carman, J. B., So. Coventry.
Chandler & Morse, Putnam.
Chamberlain, A. L. & Co., New Haven.
Chamberlin, Lewis, North Coventry.
Converse, R. S , Stafford Springs.
Cutler, J. W., Putnam.
Dakin, C. B. & Co., Sharon.
Dean, Jas. E., Winsted.
Dickerman, Elam J., Mount Carmel.
Dyen, M. S., Canton.
Eddy, Sam'l. Canaan.
Ellsworth, F., Hartford.
Emmons, S H., Moodus.
Leonard, J. E., Jewett City.
Gifford, H. M., East Woodstock.
Godfrey, E. A., Westport.
Goodman, John, East Litchfield.
Grant, Geo. W., Wapping.
Greenwood Co., New Hartford.
Griffiths, Silas, Sterling.
Gillette, C. S., Cheshire.
Hall, Henry L., 2d, Wallingford.
Hall, L. A. & Co., So. Coventry.
Hall, S. J., Meriden.
Hopson, Geo., Kent.
Hubbard. A. A., Canaan.
Hull & Sweet, So. Coventry.
James, C. D., Danielsonville.
Jones. H. L , New Hartford.
Kingsbury, Andrew, Coventry.
Knight, F. M.. Thompson.
Lewis, J. A., Willimantic.
Littlefield, Jno. E., Niantic.
Lincoln & Boss, Willimantic.
Martin Bros., Wallingford.
Martin, C. F.. Elliott.
Martin, F. W., Chaplin.
Mansfield, D. B.. Harwinton.
Merrow, J. B & Sons, Merrow.
Morgan, Daniel, Poquonnock Bridge.
Peck Bros., Northfield.
Phelps, J. P. & L. C., Hamden
Platt & Merwin, Milford.
Pratt, C. M., Westbrook.
Roberts, A. F., Lakeville.
Russell. A. S. & Co., Meriden.
Sardam. Wm., Canaan Valley.
Smith, B. E., East Granby.
Smith. C. S., Kent.
Southington Lumber & Feed Co., Southington.
Still, Andrew J., Southport.
Stillman, H. A., Hartford.
Talcott & Alvord, Torrington.
Tucker, R. H., Saybrook.
Ure, Andrew, Hamden.
Walker & Nutting, Waterbury.
Warner, D B. & Son, East Haddam.
Wilson, Allen, Suffield.
Wilson & Burr, Middletown.
Wilson, D. B. & Co., Waterbury.

The above should have had place on page 19 of this report, but was overlooked.

FERTILIZER SALES IN CONNECTICUT IN 1887.

In November last a circular was addressed to each manufacturer of fertilizers whose goods were legally sold in this state, asking for a statement of his total sales in Connecticut of the different classes of commercial fertilizers for the year ending

Nov. 1, 1887. This request was made with the promise that the statement should be regarded as strictly confidential, and that only the aggregage sales in the state by all manufacturers should be published. Twenty-nine firms complied with this request, one firm declined to comply and thirteen took no notice of the circular. The aggregate amounts reported by twenty-nine firms are as follows:

Kainit,	177
Muriate of potash,	183
Sulphate of potash,	30
Sulphate of ammonia,	40
Nitrate of soda,	69
Blood, Ammonite and Fish,	157
Other nitrogenous matters,	1,052
Bone,	1,331
Plain superphosphate,	195
Ammoniated superphosphates without potash,	53
"Complete" manures,	8,000
Total,	11,287

If the sales of the fourteen other firms were on the average as large, the total sales would be about 16,700 tons. We believe the total sales were above rather than below these figures. A moderate estimate of the cost to purchasers of this quantity of fertilizers is $500,000.

THE COMPOSITION OF AMERICAN FEEDING STUFFS.

By Dr. E. H. Jenkins.

On subsequent pages is given in tabular form the average composition of the feeding stuffs commonly used in this country, compiled exclusively from American analyses. In the first column of these tables is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

As it is very desirable to know within what limits the composition of each fodder is likely to vary, the maximum and minimum amounts of each ingredient have also been inserted in the table.

COMPOSITION OF AMERICAN FEEDING STUFFS.

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
GREEN FODDER.																	
Maize Fodder	48	7.1	30.9	*19.02*	.6	3.0	*1.63*	.1	.9	*.41*	3.2	19.7	*10.62*	1.9	11.4	*5.23*	1.13
Maize Fodder, ensilaged	57	13.0	28.4	*19.48*	.7	2.8	*1.49*	.2	1.8	*.68*	5.1	18.3	*10.26*	3.0	10.0	*5.68*	1.31
Sorghum	7	13.6	28.4	*21.66*	.9	1.4	*1.10*	.2	.5	*.36*	5.3	27.0	*13.08*	4.7	8.5	*6.25*	.87
Sorghum, ensilaged	5	22.0	28.1	*24.17*	.6	.9	*.75*	.1	.4	*.28*	13.8	19.0	*15.82*	5.9	6.8	*6.28*	1.04
Rye Fodder	6	21.9	25.3	*24.72*	2.3	3.0	*2.61*	.2	.7	*.56*	4.9	12.4	*6.94*	4.9	14.9	*12.73*	1.88
Rye Fodder, ensilaged	1	....	....	*19.25*	....	....	*2.42*	....	....	*.27*	....	....	*9.18*	....	....	*5.76*	1.62
Oat Fodder	2	21.4	28.8	*25.10*	1.5	2.0	*1.77*	.4	.7	*.57*	10.8	14.6	*12.70*	7.1	9.5	*8.27*	1.79
Clover	1	....	....	*26.67*	....	....	*4.09*	....	....	*.69*	....	....	*11.61*	....	....	*8.12*	2.16
Clover, ensilaged	3	21.5	27.4	*23.73*	3.0	3.8	*3.34*	.9	1.1	*1.02*	8.1	11.4	*10.21*	5.1	8.6	*6.66*	2.50
Cow-pea vines, green and succulent	2	14.0	17.9	*15.93*	3.0	3.3	*3.12*	.6	.6	*.60*	5.3	8.5	*6.90*	2.9	4.1	*3.48*	1.83
Beet leaves	1	....	....	*11.16*	....	....	*2.74*	....	....	*.60*	....	....	*2.49*	....	....	*2.50*	2.83
Carrot leaves	1	....	....	*16.70*	....	....	*4.26*	....	....	*.86*	....	....	*5.99*	....	....	*2.25*	3.34
Cabbage ensilage	1	....	....	*12.39*	....	....	*1.19*	....	....	*.93*	....	....	*4.52*	....	....	*1.59*	4.16
HAY AND DRY COARSE FODDER.																	
Clover hay	33	78.2	93.9	*88.63*	8.9	20.8	*12.55*	1.5	4.3	*2.44*	35.0	49.0	*40.55*	15.6	35.7	*26.86*	6.23
Hay containing much clover	10	85.5	89.8	*86.68*	6.3	14.4	*10.33*	1.5	3.1	*2.52*	31.8	45.2	*40.46*	19.7	35.1	*28.07*	5.30
White clover hay	2	91.4	92.9	*92.12*	14.1	20.0	*17.03*	2.1	5.8	*3.95*	38.2	40.6	*39.38*	20.3	27.3	*23.75*	8.00
Alsike clover hay	4	91.6	94.8	*92.63*	11.4	16.1	*13.50*	1.6	4.2	*2.35*	36.5	43.5	*40.86*	27.7	29.5	*28.61*	7.31
Lucerne hay	3	92.5	94.4	*93.52*	15.0	18.6	*17.04*	1.8	2.4	*2.05*	35.5	39.2	*37.12*	26.2	33.0	*30.21*	7.10
Timothy hay (*Phleum pratense*)	53	84.5	92.9	*89.76*	4.2	9.6	*6.06*	1.0	3.4	*2.12*	39.2	58.5	*47.10*	22.7	38.5	*30.37*	4.11
Red top hay (*Agrostis vulgaris*)	1	....	....	*90.16*	....	....	*7.25*	....	....	*1.95*	....	....	*46.52*	....	....	*27.45*	6.99
Timothy and Red top	10	85.7	91.8	*87.64*	4.8	9.0	*6.52*	1.5	2.7	*2.00*	38.5	48.9	*44.15*	24.7	38.4	*30.17*	4.80
Orchard grass hay (*Dactylis glomerata*)	4	88.2	93.5	*91.87*	3.6	8.2	*6.33*	1.4	2.4	*1.93*	33.5	48.6	*44.45*	29.7	38.3	*33.81*	5.35
Hungarian grass hay	13	91.0	95.2	*92.85*	5.0	12.3	*7.22*	1.5	3.5	*2.14*	44.4	53.0	*49.41*	23.6	31.3	*28.25*	5.83
Barley hay (seed in milk)	1	....	....	*89.75*	....	....	*9.21*	....	....	*2.47*	....	....	*47.49*	....	....	*26.14*	4.44

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
HAY.—*continued.*																	
Oat hay	3	86.3	91 3	*89.32*	7.8	9.9	*8.53*	2.1	3.1	*2.52*	36.2	48.0	*41.93*	25.1	33.6	*29.92*	6.42
High meadow hay	2	88.7	89.4	*89.02*	6 8	8.3	*7.57*	2.0	2.5	*2 25*	46 9	47.5	*47 19*	24.3	25.2	*25 78*	6.23
Hay from mixed meadow grasses	9	81.0	87.0	*84 52*	4 9	7 9	*6.24*	1.4	2.7	*2.05*	34.4	47.3	*40.43*	23.7	35.9	*31.09*	4.71
Low meadow hay	10	85.5	93.6	*89.50*	4.6	10.4	*7.70*	.7	3.6	*2.20*	39.8	55.2	*43.60*	21.4	40.0	*30.20*	5.80
Hay from salt marsh grasses	13	81.4	92.8	*89.89*	4.0	7.8	*5.69*	1.6	3.1	*2.31*	34.1	54.3	*44 10*	25.1	37.9	*30.51*	7.28
Baled hay, "extra fine"	1	....	....	*84.05*	....	....	*6.20*	....	....	*2.19*	....	....	*45.13*	....	.	*26.60*	3.93
Maize fodder, field cured	4	60.6	77.1	*65.02*	3.8	4.6	*4.23*	.6	1.6	*1.08*	30.5	40.8	*33.79*	18.7	24.7	*21.27*	4.65
Maize stover, field cured	9	63.5	83.8	*77.17*	3.8	8.3	*5.38*	1.1	1.9	*1.45*	35.8	46.2	*40.30*	19.1	29.5	*25.18*	4.86
Maize stover, dried	11	87.0	92.4	*90.43*	3.4	8.5	*5.02*	.8	1.5	*1.10*	45.3	52.9	*49.17*	26.6	33.6	*29.92*	5.23
Buckwheat straw	3	89.6	91.0	*90.09*	3.3	7.8	*5.15*	.7	1.7	*1.26*	32.1	38.9	*35.16*	37.2	46.8	*42.98*	5.54
Oat Straw	12	87.5	93.5	*91.26*	2.3	6.9	*3.82*	1.0	3.2	*2.22*	26.4	51.4	*38.89*	29.5	56.0	*41.52*	4.81
Rye straw	8	87.5	93.7	*92.24*	2.2	6.9	*3 46*	1.0	2.7	*1.40*	35.7	52.9	*38.35*	34.2	43.3	*45.25*	3.78
Wheat straw	6	82.1	93.5	*91.22*	2.9	5.0	*3.45*	.8	1.8	*1.29*	31.0	50.6	*37.33*	34.3	42.7	*44.99*	4.16
Cow-pea vines	6	86.0	90.7	*85.95*	13.6	19.8	*15.68*	1.1	4.1	*2.87*	34.9	46.4	*42.17*	17.2	23.7	*19.80*	8.41
ROOTS, BULBS, TUBERS AND OTHER VEGETABLES AND FRUIT.																	
Beets, red	2	10.5	12.3	*11.43*	1.5	1.7	*1.60*	.2	.2	*.18*	7.2	7.6	*7.40*	.6	1.7	*.12*	1.08
Beets, sugar	8	9.2	16.4	*13.03*	1.7	2.9	*2.01*	.1	.2	*.10*	5.7	12.0	*9 15*	.7	1.1	*.87*	.90
Mangolds	6	5.6	11.7	*8.68*	1.0	1.9	*1.52*	....	.5	*.16*	2.4	8.4	*5.00*	.8	1.0	*.84*	1.16
Ruta bagas	1	....	....	*12.92*	....	....	*1.15*	....	....	*.09*	....	....	*9.11*	....	....	*1.16*	1.41
Turnips	2	7.6	8.2	*7.92*	.8	1.3	*1.02*	.1	.2	*.18*	5.8	4.2	*5.03*	.8	1.2	*1.01*	.68
Carrots	6	8.9	13.5	*11.70*	.9	2.0	*1.16*	.2	.7	*.42*	5.1	10.4	*7.68*	1.0	2.3	*1.38*	1.06
Onions	6	6.5	18.4	*12.45*	.8	2.3	*1.41*	.2	.4	*.26*	3.8	14.1	*9.53*	.6	.8	*.69*	.56
Potatoes	7	19.4	24.1	*21.90*	1.1	3.0	*2.19*	....	.2	*.10*	15.3	20.0	*18.19*	.3	.9	*.54*	.88
Sweet potatoes	5	26.6	34.0	*29.37*	.5	3.6	*1.55*	.3	.6	*.38*	18.0	29.7	*25.09*	.6	2.5	*1.36*	.99

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fibre.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
ROOTS, BULBS, ETC.—*continued.*																	
Cabbage	2	6.5	10.2	*8.28*	1.8	2.0	*1.95*	.2	.5	*.33*	2.0	3.5	*2.75*	1.4	3.0	*2.21*	1.04
Squash	2	4.8	5.4	*5.12*	.6	.6	*.66*	.2	.3	*.28*	2.9	3.5	*3.24*	.5	.5	*.54*	.40
Pumpkin	1	....	....	*7.73*	....	....	*1.11*	....	....	*.16*	....	....	*4.34*	....	....	*1.49*	.63
Apples	5	15.9	22.7	*18.22*	.2	1.2	*.69*	.3	.6	*.41*	12.6	20.0	*15.31*	.9	2.9	*1.49*	.32
GRAIN AND OTHER SEEDS.																	
Barley	9	87.4	92.7	*89.08*	8.6	15.7	*12.39*	1.5	3.1	*1.86*	66.7	73.9	*69.88*	1.2	4.1	*2.57*	2.38
Buckwheat	8	85.1	89.1	*87.40*	8.6	11.1	*10.00*	2.2	2.4	*2.25*	62.6	65.4	*64.50*	7.8	9.4	*8.70*	2.00
Oats (raised in Conn.)	7	86.5	90.7	*89.06*	8.0	10.1	*9.32*	4.7	5.8	*5.29*	59.0	63.2	*61.55*	8.9	12.9	*9.95*	2.95
Oats	25	86.5	91.1	*89.06*	8.0	14.4	*11.38*	3.4	5.8	*4.81*	50.8	66.9	*60.05*	1.5	19.4	*9.85*	2.97
Rye	6	86.8	91.3	*88.40*	9.5	12.1	*10.60*	1.4	2.1	*1.70*	70.7	73.9	*72.60*	1.4	2.1	*1.60*	1.90
Wheat, winter	242	83.8	92.9	*89.48*	8.3	16.6	*11.73*	1.3	3.9	*2.11*	68.1	76.6	*72.01*	.4	2.9	*1.77*	1.86
" spring	13	86.6	91.9	*89.63*	8.1	15.4	*12.51*	1.8	2.5	*2.20*	66.1	78.6	*71.19*	1.3	2.3	*1.82*	1.91
" unclassified	55	87.6	90.9	*89.31*	9.8	14.7	*11.96*	1.6	2.8	*2.10*	68.5	74.7	*71.50*	1.2	3.1	*1.92*	1.83
" Average of all Analyses	310	83.8	92.9	*89.46*	8.1	16.6	*11.80*	1.3	3.9	*2.11*	66.1	78.7	*71.89*	.4	3.1	*1.80*	1.86
Maize, dent	80	85.9	93.7	*89.91*	7.5	12.1	*10.33*	3.8	6.9	*5.10*	66.2	75.7	*70.66*	1.2	4.8	*2.28*	1.54
" flint	70	80.4	93.4	*88.93*	7.0	13.7	*10.57*	3.4	7.1	*4.96*	65.0	74.6	*70.31*	.7	2.9	*1.65*	1.44
" sweet	26	89.1	94.0	*91.18*	9.5	15.3	*11.62*	3.8	11.9	*8.14*	61.8	72.4	*66.70*	1.5	5.2	*2.80*	1.92
" "Western Corn"	3	79.3	83.6	*80.90*	7.8	8.6	*8.30*	3.6	3.9	*3.70*	64.9	68.2	*66.00*	1.7	1.8	*1.75*	1.20
" Average of all Analyses	192	79.3	94.0	*89.49*	7.0	15.3	*10.55*	3.4	11.9	*5.45*	61.8	75.7	*69.85*	.7	5.2	*2.09*	1.54
Sorghum Seed	9	83.2	90.7	*87.48*	7.6	11.2	*8.88*	2.1	4.6	*3.65*	66.8	73.6	*71.26*	1.4	3.2	*1.88*	1.80
Cotton Seed, hulls and kernels	1	....	....	*92.28*	....	....	*15.72*	..	..	*18.56*	....	....	*29.09*	....	....	*25.73*	3.16
Cow Pea	5	79.2	89.9	*85.21*	19.3	23.0	*20.77*	1.3	1.6	*1.43*	48.1	61.9	*55.75*	3.3	5.0	*4.06*	3.20
Soy Bean	4	86.9	93.9	*91.53*	34.6	40.2	*37.22*	12.3	19.0	*16.52*	26.2	30.5	*28.21*	3.7	5.0	*5.12*	4.46

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
FLOUR AND MEAL.																	
Barley Meal	3	83.8	86.0	*84.90*	8.8	13.9	*11.80*	.7	2.2	*1.70*	....	....	*70.90*	....	....	*.10*	.50
Buckwheat Flour	4	82.4	87.2	*85.46*	4.2	8.1	*6.89*	.7	1.8	*1.44*	71.1	79.4	*75.79*	.2	.5	*.34*	1.00
Oat Meal	6	91.1	93.8	*92.15*	12.9	16.2	*14.66*	6.1	8.8	*7.06*	66.6	68.9	*67.57*	.6	1.2	*.86*	2.00
Rye Flour	4	86.4	87.7	*86.90*	6.0	7.1	*6.65*	.8	.9	*.84*	77.6	79.1	*78.28*	.4	.5	*.41*	.72
Wheat Flour, from Winter Wheat*	1	....	....	*87.04*	....	....	*8 56*	....	....	*1.19*	....	....	*76.59*	....	....	*.17*	.53
" from Spring Wheat†	6	86.5	89.7	*87.68*	8.6	14.1	*10.68*	.6	2.0	*1.11*	68.3	78.1	*75.00*	....	1.2	*.22*	.64
" Unclassified	21	86.4	88.8	*87.52*	9.7	13.3	*11.25*	.8	1.9	*1.16*	69.5	76.9	*74.33*	.1	1.0	*.25*	.53
" Average of all varieties	25	86.4	89.7	*87.44*	8.6	14.1	*11.28*	.6	2.0	*1.20*	68.3	78.1	*74.13*	.0	1.2	*.27*	.56
Graham Flour	3	86.3	87.9	*86.90*	11.3	12.4	*11.70*	1.5	1.9	*1.70*	69.8	70.0	*69.80*	1.8	2.1	*1.90*	1.80
Maize Meal	56	74.5	92.0	*84.15*	7.1	10.3	*9.16*	2.2	5.1	*3.81*	57.0	74.0	*67.84*	.5	2.8	*1.80*	1.46
Hominy	2	86.4	86.6	*86.50*	8.1	8.4	*8.25*	.4	.5	*.44*	77.1	77.2	*77.12*	.3	.3	*.32*	.38
Sorghum Meal, mostly decorticated	1	....	....	*86.84*	....	....	*8.25*	....	....	*3.85*	....	....	*71.27*	....	....	*1.88*	1.59
Pea Meal	2	87.0	91.2	*89.54*	19.1	21.4	*10.23*	.9	1.5	*1.19*	50.2	52.0	*51.09*	11.1	17.7	*14.33*	2.64
BY PRODUCTS AND REFUSE.																	
Apple Pomace	7	22.1	27.4	*22.94*	1.0	1.7	*1.40*	.6	2.0	*1.36*	12.6	17.6	*15.63*	2.0	5.9	*4.01*	.54
Brewers' Grains, wet from brewery	15	20.6	31.4	*24.99*	4.3	7.7	*5.57*	.8	2.9	*1.68*	10.1	15.7	*12.86*	3.0	5.6	*3.87*	1.01
" " "dried"	3	88.1	93.8	*91.81*	19.2	20.2	*19.89*	4.2	6.5	*5.56*	46.1	56.8	*51.75*	10.2	11.6	*11.01*	3.58
" " kiln-dried	1	....	....	*97.43*	....	....	*20.30*	....	....	*6.40*	....	....	*54.89*	....	....	*11.79*	3.97
" " from Silo	3	26.1	33.2	*30.18*	5.8	7.1	*6.64*	1.8	2.5	*2.11*	13.6	16.8	*15.58*	3.9	5.4	*4.64*	1.21
Brewers's Swill	1	....	....	*5.70*	....	....	*1.90*	....	....	*.80*	....	....	*2.00*	....	....	*.70*	.30
Malt Sprouts	3	88.0	92.7	*89 72*	21.0	25.9	*22.95*	1.1	2.9	*1.79*	45.4	50.3	*48.60*	9.3	11.9	*10.72*	5.67
Cotton Seed Meal	29	81.5	94.2	*91.68*	23.3	50.8	*42.39*	10.2	18.0	*13.37*	12 7	38.6	*22.97*	2.7	11.7	*5.69*	7.26

* The average of 18 analyses, most of them incomplete, is: Total dry matter, 89.63; Ash, 64; Albuminoids, 10.[illegible]2.

† The average of 16 analyses, most of them incomplete, is: Total dry matter, 88 55; Ash, 60; Albuminoids, 11.63.

COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

Name.	Analyses.	Total Dry Matter.			Albuminoids or Protein.			Crude Fat.			Nitrogen-free Extract.			Fiber.			Ash.
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	
BY PRODUCTS AND REFUSE—*continued.*																	
Linseed Meal, Old Process	12	87.4	93.9	*90.97*	27.7	38.2	*32.33*	5.1	11.6	*8.24*	30.8	41.9	*35.22*	7.1	13.3	*9.31*	5.87
" New Process	12	86.6	93.2	*89.25*	27.1	37.1	*32.85*	1.3	4.4	*3.08*	35.2	48.0	*38.29*	7.6	14.0	*9.46*	5.57
" Oil not removed	1	....	....	*91.67*	....	....	*22.97*	....	....	*30.26*	....	....	*25.48*	....	....	*9.60*	3.36
Palm Nut Meal	3	89.1	93.8	*91.71*	13.5	16.0	*14.39*	6.4	18.7	*13.30*	33.8	41.6	*38.88*	18.7	23.9	*21.40*	3.74
Rye Bran	6	86 3	91.8	*88.51*	11.5	16.8	*15.28*	1.8	4.9	*2.46*	59.8	67.6	*63.66*	2.5	4.1	*3.52*	3.59
Wheat Bran	63	84.2	91.8	*87.72*	7.5	16.9	*15.07*	1.5	5.9	*3.78*	50.0	67.6	*54.26*	2.4	17.8	*8.71*	5.70
" Middlings	27	84.0	91.5	*88.00*	10.1	19.2	*15.17*	1.3	12.7	*4.01*	53.0	70.9	*60.99*	2.1	5.9	*4.57*	3.26
" Shorts	8	84 5	89.0	*87.26*	11.1	16.1	*13.83*	2.5	5.3	*4.14*	53.3	67.0	*57.59*	5.8	10.5	*7.45*	4.25
"Hominy Chops," "Hominy Feed," "Baltimore Meal," "White Meal"	11	86.5	91.9	*88.86*	7.9	11.2	*9.85*	4.6	11.2	*8.43*	61.0	71.1	*64.49*	2.5	4.8	*3.59*	2.50
Gluten Meal	11	88.3	92.7	*90.61*	25.0	35.0	*29.58*	4.2	8.7	*6.31*	44.7	58.5	*52.64*	.7	3.8	*1.34*	.74
Maize Cob	13	85.6	92.8	*90.67*	1.2	3.7	*2.50*	.1	.9	*.45*	45.3	66.4	*55.99*	28.2	38.2	*30.36*	1.33
"Starch Feed," refuse from starch manufacture	8	27.8	37.7	*34.34*	3.6	7.7	*5.73*	1.3	4.3	*3.02*	18.7	28.9	*22.21*	1.6	4.3	*3.17*	.21
"Sugar Feed," kiln-dried, refuse from glucose manufacture	2	89.6	93.4	*91.50*	13.1	13.5	*13.30*	5.9	11.2	*8.60*	54.9	61.4	*58.10*	8.4	10.7	*9.50*	2.00
Sorghum Bagasse	4	11.3	16.6	*14.50*	.6	.7	*.65*	....	....	....	....	....	*10.20*	2.8	3.3	*3.10*	.60

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